

DOES NOT CIRCULATE

# SCIENCE

UNIVERSITY  
OF MICHIGAN

MAR 15 1955

MEDICAL  
LIBRARY

11 MARCH 1955

VOLUME 121

NUMBER 3141

How I Discovered Phase Contrast: *F. Zernike* ..... 345

George James Peirce, Pioneer American Plant Physiologist:  
*G. M. Smith* ..... 349

## News and Notes

A Cytological Congress; AAAS Socio-Psychological Prize; and  
Regular Departments ..... 350

## Book Reviews

*Fundamentals of Electric Log Interpretation; Los Trigos de la Ceres  
Hispanica de Lagasca y Clemente; Progress in Metal Physics; Modern  
Experiments in Telepathy; Complex Variable Theory and Transform  
Calculus; Coalfields of Great Britain; Endokrinologische Psychiatrie;  
Diagnosis and Treatment of the Acute Phase of Poliomyelitis and Its  
Complications; Television* ..... 360

## Technical Papers

Potential of Pentobarbital Anesthesia by Isonicotinic Acid  
Hydrazide and Related Compounds: *A. Goldin et al.* ..... 364

Relationship of Hallucinogens to Adrenergic Cerebral  
Neurohumors: *A. S. Marrazzi and E. R. Hart* ..... 365

Alkaloid Formation in Ergot Sclerotia: *Y. H. Loo and R. W. Lewis* ..... 367

Anticortisol Action of Aldosterone: *H. Selye* ..... 368

Gramine Derivatives Antagonistic to 5-Hydroxytryptamine  
(Enteramine): *V. Erspamer* ..... 369

## Communications

New Technique for Motivating and Reinforcing Children:  
*W. E. Jeffrey* ..... 371

Bonding in the Lanthanum Chelates: *M. M. Jones* ..... 371

New Hemoglobin Possessing a Higher Electrophoretic Mobility than  
Normal Adult Hemoglobin: *D. A. Rigas, R. D. Koler, E. E. Osgood* ..... 372

Use of Auditory Stimuli to Maintain Lever-Pressing Behavior:  
*J. M. Harrison and W. H. Tracy* ..... 373

Inexpensive Stain for Paper Electrophoresis:  
*L. A. Rideout and R. W. Prichard* ..... 374

Science and the Public ..... 7A

Meetings & Conferences ..... 10A

AMERICAN ASSOCIATION FOR THE  
ADVANCEMENT OF SCIENCE

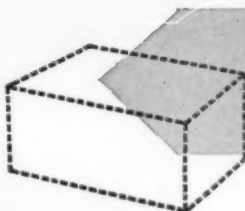
how Lab-aid's

*45% greater capacity*  
cuts filing costs . . . saves floor space

a single Lab-aid cabinet holds up to 6500 (average) 1" microslides.



other type files need up to this much more space to hold as many.



How can a "Lab-aid" filing cabinet pack so much in so little space?

Look at one to see. You'll find no thick bulkheads between drawers, no space-consuming buttresses, no bulky tracking guides.

Every cubic inch inside is a hard-working "storage inch." The patented "Lab-aid" construction gets fourteen full-length drawers in a cabinet only 19" square. Yet, close-set as they are, every drawer slides straight and true, easily, smoothly, without binding.

Drawers are freely interchangeable, too. Use 1", 2", and 4" capacity full-length drawers in the same unit, in any arrangement you want,

for microslides, transparencies, lantern slides, cards, etc. And use any of them anytime for spaced filing instantly. Lift out the separator, and you clear the drawers for close-packed storage.

Other units in the "Lab-aid" line provide for flat-filing microslides . . . for filing paraffin blocks, for "frame-spread" transparency filing. All are staunchly built of heavy gauge steel, strongly welded throughout. All have the same basic 19" square dimension, so they stack rigidly to any convenient height.

Write for the catalog describing these uniquely efficient "Lab-aid" filing cabinets..

... because every inch is a filing inch



TECHNICON

*Lab-aid*

laboratory filing equipment

THE TECHNICON COMPANY  
Chauncey, New York

These same Cabinets are manufactured by our French Corporation:  
COMPAGNIE TECHNICON • 7 rue Georges Ville • Paris

# How I Discovered Phase Contrast\*

F. Zernike

*Department of Physics, University of Groningen, Netherlands*

**P**HASE CONTRAST was not discovered while I was working with a microscope, but while I was working in a different part of optics. It originated in my interest in diffraction gratings, which began about 1920. A diffraction grating consists of a plane or concave mirror with a large number of equidistant grooves ruled on its surface. Small nearly unavoidable imperfections in the location of the grooves show clearly in the optical behavior of the grating. The most conspicuous error is a periodic one that repeats itself after each revolution of the screw of the ruling engine. The regularly recurring displacement of the grooves causes corresponding changes of the optical path, just as if the mirror surface were wavy. Consequently the instrument behaves as if a coarse grating, with a constant of about 2 mm, were superimposed on it, with the result that each strong spectral line is accompanied to its right and left by a number of weak spurious lines, the so-called "Rowland ghosts." These lines have a remarkable effect if one looks down at the surface of the grating, placing the eye at the position of a spectral line. A perfect grating would in this case show an evenly illuminated surface in the color of the spectral line. In reality, however, one sees a strongly striped surface.

At the end of a 1902 paper H. S. Allen remarked that these stripes were nothing real but were simply the effect of the interference between the principal line and its ghosts. Indeed the stripes disappear when the ghosts are covered up. I remember strongly objecting to his conclusion of unreality. On the contrary, I was convinced that the striped surface gave more information about the periodic ruling errors than that obtainable by photographing the ghosts, because in the first case, the relative phases of the ghosts come into play, whereas these are lost in the second case. I kept the question in mind, planning to look further into it as soon as an opportunity arrived.

About 1930 our laboratory obtained a large concave grating ruled by Wood and set it up in a Runge-Paschen mounting. The striped appearance of the surface was soon found, but because the grating was 6 m from the eye, I tried pointing a small telescope at it. Then the unexpected happened. The stripes could be seen very clearly, but they disappeared when the telescope was exactly focused on the surface of the grating! By a succession of experiments and calculations I soon succeeded in explaining this.

On looking back to this event, I am impressed by

the great limitations of the human mind. How quick we are to learn—that is, to imitate what others have done or thought before—and how slow to understand—that is, to see the deeper connections. Slowest of all, however, are we in inventing new connections or even in applying old ideas in a new field. In my case the really new point was that the ghosts differed in phase from the principal line. Now it is common knowledge that in all interference phenomena differences of phase are all-important. Why then had phases never been considered before in this case or in the corresponding one in the microscope?

Some excuse may be found in the difficulty to define them exactly. Let me explain this for a simpler case, the diffraction image of a slit. The way to observe this may be as follows. A telescope is pointed at a vertical line-source of light, such as the filament of an incandescent lamp. A vertical slit of, say, 2 mm width is placed close behind the objective of the telescope. This causes the image of the source to be broadened out into a diffraction pattern: a bright central stripe (order zero) is accompanied on both sides by weaker and weaker secondary maxima (orders one, two, and so forth). The formula for this diffraction pattern is given in the textbooks, the amplitude being determined by the function  $\sin x/x$ . In the few cases where the phases are mentioned in the literature, on the other hand, there is no consensus. Some say that the phases are equal over the whole pattern—except for the obvious reversal of the odd orders—whereas others make them change proportional to  $x^2$ . I find that it all depends on the surface, often tacitly assumed, to which the phases are referred. If this reference surface is the focal plane of the telescope objective, one comes to the second statement, if it is a cylindrical surface with the center line of the slit as its axis, the equality of phases results.

You may want to ask whether these phases can be observed. I find they can. All one has to do is to throw the diffraction image on a *coherent background* obtained in the following way. The slit is covered by a glass plate with a thin metallic layer that transmits a small percentage of the light. A fine scratch is made in this layer, forming a narrow slit that is adjusted until it lies in the center of the broad slit. The light through the scratch is broadened out by diffraction and thus forms the desired background, which interferes with the diffraction pattern. The phases of this pattern are thus compared with those of the auxiliary wave forming the background. In the experiment the auxiliary wavefront therefore plays the role of the cylindrical reference surface in the theoretical treatment.

It is only by the introduction of an adequate refer-

\* This article is, with some minor alterations, Dr. Zernike's Nobel prize address delivered in Stockholm, Sweden, when the 1953 award in physics was made. It is published with permission of the Nobel Foundation and will also appear in *Lee Prize Nobel 1953*.

ence surface that a definite statement about the phase differences involved can be made. In the case of the Rowland ghosts the result was that their phases differ by  $90^\circ$  from the principal line. Now I happened to know of a simple method to change this. Lord Rayleigh described in 1900 how to make very shallow etchings in glass surfaces without spoiling their optical quality, by the slow action of very dilute hydrofluoric acid. By this process I made what I called *phase strips*: glass plates with a straight groove, 1 mm or less wide and of a uniform depth of half a wavelength. Such a phase plate was placed in the spectrum so that a bright spectral line fell on the strip, whereas its ghosts passed through the glass beside it. In a telescope behind the phase plate the stripes on the grating surface then stood out clearly.

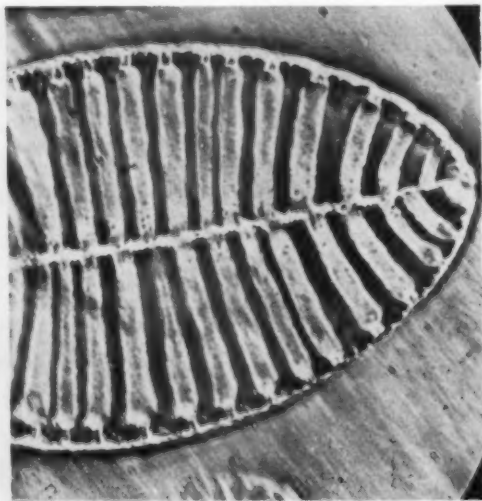
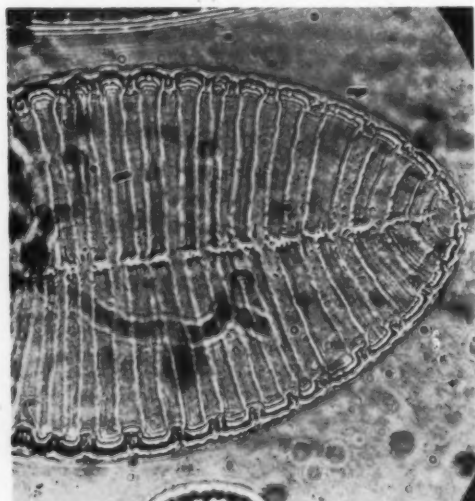
For a physicist interested in optics it was not a great step to change over from this subject to the microscope. Remember that in Ernst Abbe's remarkable theory of the microscope image the transparent object under the microscope is compared with a grating. To be precise a transmission grating is considered as the test object and the diffraction by this grating as the primary phenomenon. At first sight this has nothing to do with the magnified image of the object formed by the microscope objective. Instead, the objective forms an image of the light source, practically in its back focal plane, consisting of a central direct image accompanied by diffracted images on both sides. This, although on a very much smaller scale, is the analog of the grating line with its ghosts. The light issuing from these images overlaps in the eyepiece of the microscope and by interference gives rise to stripes which, curiously enough, resemble a magnified image of the object! Abbe's theory has been summar-

ized in this sentence: "The microscope image is the interference effect of a diffraction phenomenon."

It is easy to see that, acquainted with this theory, I soon tried my phase strip in a microscope, throwing the direct image of a linear light source on the strip placed close above a low-power objective.

I must now explain why the unexpected discovery of the  $90^\circ$  phase shift applies to the microscope image as well. It all depends on the nature of the object under the microscope. In his theory Abbe and his followers always considered an object of alternate opaque and transparent strips. The diffraction images for such a grating, calculated in the well-known way, are in phase with the central image. On the other hand, if the object consists of alternate thicker and thinner transparent strips, then the phase difference of  $90^\circ$  is found. In the first case, the diffraction is caused by the unequal *amplitudes* of the light passing the strips; in the second case, it is caused by the unequal light paths, that is, by the unequal *phases*. I therefore distinguish the two by calling the first kind an *amplitude grating*, the second a *phase grating*, or in the general case of an irregular structure, an *amplitude object* and a *phase object*, respectively. Nearly all objects of biological or medical interest belong naturally in the second group. The highly developed staining techniques evidently aim at changing them, or the special details one wants to see, into amplitude objects.

It will now be seen that for a phase object my phase strip in the focal plane of the microscope objective brought the direct image of the light source into phase with the diffracted images, making the whole comparable to the images caused by an amplitude object. Therefore the image in the eyepiece ap-



(Left) A diatom with brightfield (traditional narrow iris diaphragm). (Right) The same with phase contrast. Oldest photomicrograph by the author, 1932.



pears as that of an absorbing object—that is, with black and white contrast, just as if the object had been stained. The full name of the new method of microscopy might be something like “phase-strip method for observing phase objects in good contrast.” I shortened this into *phase contrast method*. Before going into further practical details about the development of the method, a few general remarks should be made.

In a treatise on the Abbe theory, Otto Lummer comes to the conclusion that “in the ideal case the microscope image is exactly similar to the object in structure and phase.” Now the absolutely transparent details of a phase object leave the intensity of the passing light unchanged. All they do is impress phase differences on it. According to Lummer, then, the image will show the same phase differences, which however are invisible, and an equal intensity everywhere. In other words, the phase object is absolutely invisible “in the ideal case.” Of course the practical microscopist has never been content with this; as a matter of fact, he has never found it out! Without realizing it, he has always turned the fine adjustment—that is, put the object a little out of focus—in order to see the tricky transparent details. Only a somewhat diffuse and watery image is obtained in this way. This also could be exactly explained by the wave theory.

With the phase contrast method still in the first somewhat primitive stage, I went in 1932 to the Zeiss works in Jena to demonstrate it. It was not received with as much enthusiasm as I had expected. This may be explained by the following facts. The great achievements of the firm in practical and theoretical microscopy were all the result of the work of their famous leader Ernst Abbe and dated from before 1890, the year in which Abbe became sole proprietor of the Zeiss works. After 1890 Abbe was absorbed in administrative and social problems, and partly also in other fields of optics. Indeed his last work on microscopy dates from that same year. In it he gave a simple reason for the difficulties with transparent objects, which we now see was insufficient. His increasing staff of scientific collaborators, evidently under the influence of his inspiring personality, formed the tradition that everything worth knowing or trying in microscopy had been already achieved.

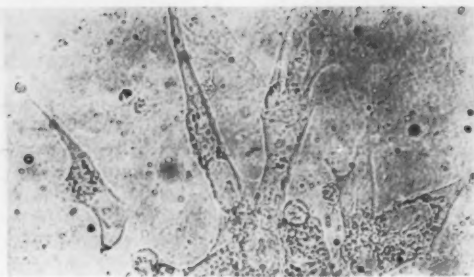
Here is one more remarkable historical point. Whereas all the other achievements of Abbe's were greatly appreciated by all practical microscope users, his theory of image formation was firmly rejected by most of them. To the physicist this may seem incredible, especially when he remembers Abbe's experiments, which in his opinion confirm the theory in a convincing way. The opposing microscopists, however, said these experiments showed only how the microscope may be used, or rather misused, by the physicist for interference experiments that have nothing to do with the ordinary proper use of the instrument. A long story could be told about the violent controversies of this kind that occurred time and again through half a century. This can now be understood because the



Dr. Zernike in his laboratory, November 1953.

theory of Abbe and his followers was too abstract and had been applied only to the oversimplified cases of a point source of light and an object of regular structure. But then it was also incomplete, for it did not explain the peculiarities in the imaging of transparent objects; what is worse, its defenders never recognized this incompleteness. Small wonder therefore that the microscopists rejected the theory as useless in practice.

Returning to the phase contrast method, I will now give a consistent account of its working principle. Let the incident light for simplicity be a plane wave. Without an object—that is, if there is only a clear glass plate under the microscope—this wave passes unchanged, is brought to a focus closely above the objective (in its back focal plane), and spreads out again to an evenly illuminated field in the eyepiece. If there is a real object, every small detail of it will give rise to a slight perturbation of the wave. One may always consider this as resulting from a perturbed wave to be superimposed—in amplitude, not in energy—on the unchanged wave. This last one shall be called the *direct light*; it will clearly give the even background. The perturbed wave will spread out from the detail in all directions, will fill the whole aperture of the objective, and will reunite in the corresponding image point in the eyepiece. The perturbed waves from all the object points together will be called the *diffracted light*. The microscope image in the eyepiece now results from the interference of the diffracted light with the direct light. In order to obtain phase contrast the two must be treated differently, in order to change their relative phases. This is possible because they are spatially separated in the back focal plane of the objective. The interplay of phases in this



(Left) Living tissue culture with phase contrast. (Right) The same with brightfield.

decomposing and reuniting of vibrations can best be visualized in a vector diagram (Fig. 1, left). As is well known, a harmonic vibration is obtained from a vector  $MV$  rotating uniformly around  $M$ . The projection  $P$  on the horizontal axis performs the vibration. The point  $P'$ , obtained by projection of  $MV'$  which remains always perpendicular to  $MV$ , performs a similar vibration, one quarter period in advance of  $P$ . In accordance with general usage, the projecting is understood, and we speak of the vibrations  $MV$ ,  $MV'$ , and so forth.

Now consider a microscopic object with slightly absorbing details on a transparent background (stained preparation). The incident vibration may be represented by  $MA$  (Fig. 1, center). An absorbing detail weakens the light, and it gets a smaller amplitude, such as  $MD$ . The vector  $MD$  results also from compounding  $MA$  with  $MD'$ , with the result that  $MD'$  represents the change caused by the detail, that is, the perturbed vibration. Now according to a well-known theorem the optical paths along all rays from an object point to its image are equal. Therefore the direct and the diffracted vibrations arrive at the image point in the same relative phases they had in the object, and the center diagram in Fig. 1 may thus serve for the reuniting of these vibrations. As a result the absorbing detail is seen darker than the background. Now compare this with the case of a transparent object (unstained preparation). Its details will ordinarily be somewhat stronger refracting than the imbedding medium. This means that the light is propagated with less speed and therefore that the emerging vibration  $MD$  (Fig. 1, right) will be retarded in phase compared with  $MA$  but equal in amplitude. The change caused by the detail is now represented by  $MD'$ , nearly perpendicular to  $MA$ . The compounding of these in the image again gives  $MD$ , equal in intensity to the background  $MA$ , and the detail remains

invisible. It will appear, however, on slightly defocusing, because the light paths are no longer equal in that case, resulting in some change of respective phases. At the same time the image becomes blurred, and the observer has to find a compromise between its disappearance from the first cause, exact focus, and from the other, fading out by lack of focus. In the phase contrast method, however, the direct light has to pass the phase strip, which is thinner than its surroundings, through which the diffracted light passes. The direct light is thus advanced by  $90^\circ$ , being then represented by  $MPh$ . This causes the detail to be represented by the vector sum of  $MPh$  and  $MD'$ , making it darker than the background. Clearly the relationships are about the same as they are in the center diagram (Fig. 1), and the transparent detail may be said to be "optically stained."

Two further improvements of phase contrast, which I made in the first years, can now be explained. One is the absorbing phase strip. Details in the object that are very thin will cause only very small phase differences. This corresponds (Fig. 1, right) to a very short vector  $MD'$ , to be compounded with  $MPh$ . The thin detail therefore appears only very little darker than its surroundings, that is, with very little contrast. Now there is no simple way of increasing the amplitude  $MD'$  of the diffracted light, but the same result, increased contrast, may be attained by diminishing the amplitude of the direct light  $MPh$ . To accomplish this the phase strip must not only accelerate the direct light but also partly absorb it. This is obtained, for instance, by a thin metallic deposit on the strip. An absorption of 75 percent is often used; the strip then transmits 25 percent of the energy, or one-half of the amplitude of the direct light. The contrast is thus doubled, a quite marked effect. In my own experiments I could go down to 4-percent transmission, that is, a 5-times enhanced contrast, the limit being set by the unavoidable stray light. It is only under especially favorable circumstances that a higher increase has been attained by the French astronomer Lyot. In his study of the minute ripples of polished lens surfaces he had independently rediscovered phase contrast and could use strips that diminished the amplitude to one-thirtieth, so that ripples only one one-thousandth of a wavelength high showed in good contrast.

A last point to explain is the halo that is always

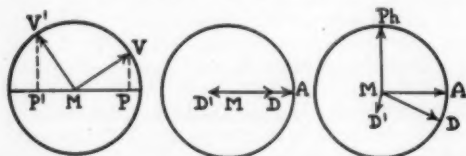


Fig. 1. Vector diagrams showing the interplay of phases.

observed surrounding objects that show great contrast. This must be ascribed to the action of the phase strip on the diffracted light. As we saw before, the phase strip is meant to act only on the direct light. However, the diffracted light, which fills the whole aperture of the objective, will for a small part be intercepted by the phase strip, and this part remains inactive. To find the effect of this missing part, we consider the reverse case, that it would be the only active part. Because of the narrow strip, it would form an image of much less resolving power, that is, blurred by diffraction. Because this part is missing, the "strip image" must be subtracted, in amplitude, from the full image formed by the whole aperture. The interference with the direct light then results in a very diffuse and weak negative image, appearing as a

bright halo around dark details and as a dark halo around bright details.

With the straight phase strips used in the beginning, the halo may be disturbing, because the strip image of a small detail is by diffraction spread out in only one direction, namely, perpendicular to the strip. This makes small bright spots in the image appear as if they were marked by short, crossing pencil streaks. To remedy this I soon introduced *annular strips*, which make the halo spread out in all directions, so that it is much fainter and indeed quite harmless.

Zeiss in Jena slowly continued with the design of instruments. After several more of my visits, after some years of development work, and after further delay by the war, they brought out phase contrast objectives and accessories in 1942.

## George James Peirce, Pioneer American Plant Physiologist

THE death of George James Peirce on 15 October 1954 marks the passing of a man whose scientific career spanned the entire development of plant physiology in the United States. He was born in Manila on 13 March 1868; when he was 6 years old he returned to the United States with his widowed mother, who established a home in Cambridge, Massachusetts. And after receiving his secondary education in the public schools of Cambridge, Peirce entered Harvard University and graduated in 1890.

Peirce majored in botany at Harvard, and the teacher most influential in directing him toward a particular discipline of botany was George L. Goodale. Goodale's special field of interest was what was called "physiological botany," which placed greater emphasis on structure than on function. Two years after graduating from Harvard, Peirce went to Germany for graduate study. It was natural that, as a man trained under Goodale, he should study both plant anatomy and plant physiology. The first semester in Germany was spent at Bonn in the laboratory of Strasburger, the great plant morphologist. The remainder of his time abroad was spent at Leipzig, primarily in the laboratory of the plant physiologist Pfeffer. In addition, Peirce received extensive training from Fischer in the infant science of bacteriology. His dissertation for the doctorate, which was granted in 1894, was prepared under the guidance of Pfeffer and was entitled "A contribution to the physiology of the genus *Cuscuta*."

Although Peirce did little original research in bacteriology, he remained interested in its development for many years. However, it is of interest to note that he was the first to offer a course in bacteriology both at Indiana University and at Stanford University. He was among the first in the United States to trace

the source of epidemics of typhoid. At Bloomington, Indiana, the source of an epidemic was found to be contamination of the water supply; at Palo Alto, California, it was traced to the milk supplied by a local dairyman.

Upon returning to the United States in 1895, Peirce was appointed assistant professor of botany at Indiana. Two years later he joined the faculty at Stanford, an institution with which he remained associated for the next 59 years. From his first year at Stanford and until he became emeritus in 1933, his primary teaching activity was in the field of plant physiology. In his course on experimental physiology, offered during his first year at Stanford, the emphasis was on function instead of on structure, as in the "physiological botany" he had been taught the decade before.

To Peirce plant physiology was not exclusively a laboratory science but rather was one where illustrative material should be drawn from the outdoors whenever possible. His two books on plant physiology, *Plant Physiology* (1903) and *The Physiology of Plants* (1926), mention numerous examples of the physiology of plants growing in the open. When the weather was favorable, he often took his class in plant physiology outdoors for the lecture. The lectures were presented in a small garden near his laboratory, where he could emphasize a point by directing the students' attention to a nearby plant. Emphasis in the plant physiology that was taught 50 years ago was quite different from that of today. This is well illustrated by the space devoted to different topics in his *Plant Physiology*. At that time the subject of irritability occupied the attention of many plant physiologists, and so it is not surprising to find that nearly a quarter of the book is taken up by the chapter entitled "Irritability." This is in contrast with present-day treatises on plant physiology, in which no author

devotes a chapter to the topic and several do not think it a subject worth listing in the index.

The research activities of Peirce during his first decade at Stanford covered a wide range of plants, including algae, lichens, liverworts, gymnosperms, and angiosperms. In many cases the stimulus for undertaking an investigation can be seen in his keen eye and inquiring mind when outdoors. Examples of this are his studies on colorless shoots growing from stumps of redwood and on the explosive discharge of antherozoids by certain liverworts.

The small number of articles published by Peirce in botanical journals during the following decade might lead to the erroneous assumption that he had done little research during this time. This is far from the case. The results of investigations during these years are available, but to find them one must go to the records of various federal and state courts instead of to scientific journals. The shift in the field of investigation arose through a proposal to build a large copper smelter a few miles north of Stanford. In order to forecast the probable effects on the vegetation of the area, Peirce was appointed a member of a panel commissioned to visit all other copper smelters in the United States that handled 1000 tons or more of sulfurous copper per day and to observe their effect on the surrounding vegetation. These field observations were supplemented by extensive studies on various plants in a greenhouse where definite amounts of one or more of the ordinary constituents

of smelter smoke were introduced into the air. As a result of these and further studies, Peirce appeared as an expert witness in several suits involving damage to vegetation by fumes from smelters. In southern California he studied the extent of the damage to citrus groves that had been caused by cement dust from a nearby cement mill. In connection with this, he devised a quantitative method for showing the extent to which a layer of cement dust on a leaf reduces photosynthesis.

About 1920 Peirce turned to a new field of investigation—the ascent of sap in trees. A summary of his theory on the manner in which sap moves up a stem comprised his address as retiring president of the Botanical Society of America in 1933. This address, entitled "Observations on sap hydraulics," was published in 1934 in the *American Journal of Botany*.

George Peirce was a man greatly beloved by students and colleagues. As the memorial resolution adopted by the faculty of Stanford well states:

His general philosophy of life was built around the central theme that to get the most out of life one must serve the University, the community, and one's fellow citizens with humility and a cheerful kindness. He lived his philosophy consistently and with a constant twinkle in his eye. His kindness was to him no effort—it was his way of life.

GILBERT M. SMITH

Department of Biological Sciences,  
Stanford University, California

## News and Notes

### A Cytological Congress

*We present two reports on the 8th International Congress for Cell Biology for reasons suggested in the introduction to G. Pontecorvo's report: confusion between the terms cell biology and cytology. Several of last summer's lists of Meetings and Conferences in Science (21 May, 18 June, and 16, 23, and 30 July) contained the following items for September, always separated by one other item:*

- 1-7. International Soc. for Cell Biology, 8th, Leiden, Netherlands. (W. H. K. Karstans, Botanical Laboratory, State University, Nonnensteig 3, Leiden.)
- 1-8. International Cytological Cong., Leiden, Netherlands. (P. G. Gaillard, Histologisch Laboratorium, Rijksuniversiteit, Leiden.)

*We solicited two reports. Two arrived and our confusion became apparent. We believe the two complement each other and publish both with the permission of both authors.*

The 8th congress of the International Society for Cell Biology was held in Leiden 1-8 Sept. 1954. About 300 biologists from Europe, Israel, the Americas, Japan, and India met in the picturesque Dutch university town. The meetings were held in the University Hospital and visitors were housed in Noord-

wijk, a North Sea resort a few miles away. The half-hour run in the streetcar to Leiden provided welcome opportunities for informal discussions or for simply enjoying the lush green of the Dutch landscape spotted with the vivid color patches of flower beds and crisscrossed by large and small waterways alive with windmills and boats.

The congress was divided into plenary sessions in the mornings, with 3 lectures of a general nature reviewing various fields of cellular biology, and meetings of 3 to 4 concurrent sections in the afternoons where short papers in the same fields were read. The main topics were (i) induced enzyme synthesis; (ii) intercellular substances in animals and plants; (iii) immunobiological concepts of growth and differentiation; (iv) biochemistry of gene action; (v) virus synthesis; (vi) mitochondria; (vii) nuclear and chromosome structure; (viii) thyroid secretion; (ix) morphogenetic interaction between cells; (x) cell division and mitotic poisons; (xi) active cell surface; (xii) submicroscopic organization of cytoplasm. There were also two sessions on cytochemistry and one on tissue culture. (Abstracts of the papers were printed in *Excerpta Medica* 8, No. 9).

From these topics and the titles of the papers presented one can see the wide ramifications of cell re-



search, which extends into almost every field of biology and connects with biochemistry and biophysics. To some extent such a meeting indicates the state of knowledge in the field and the directions in which research is moving. Most of the introductory lectures were very useful in doing this for various branches of cell research.

The formation of specific proteins in cells was illuminated, especially by reports on the study of induced enzyme synthesis. Experiments on yeast indicate that new enzyme is made directly from amino acids rather than from a more complex precursor and confirm the suggestion that ribonucleic acid is somehow involved in this process. The appearance of specific enzymes during ontogeny was used to study cellular differentiation. The sensitivity of serological methods was taken advantage of in the analysis of problems of cell growth, cellular differentiation, and interaction between cells and between cells and tissue fluids. In some cases it was possible to approach these problems in terms of changes in specific molecular populations.

Our knowledge of the intercellular substance in animals and plants was advanced through the use of new cytochemical methods and electron microscopy. Thus the chemical nature of this material in which most cells are imbedded, as well as its submicroscopic structure, has been explored. The nature of collagen and cellulose and the ways in which they are laid down by cells were discussed. The application of chemical techniques such as paper chromatography has given the geneticists new means of analyzing the effect of gene mutations and has strikingly shown that single gene mutations cause manifold changes in the phenotype, sometimes expressed morphologically but more often in the invisible chemical make up of cells. Viruses were discussed as examples of primitive cells but also because they produce profound changes in the structure and activity of cells. The formation of new virus particles has usually been the major interest and it was emphasized that more attention should be given to the metabolic aspects of the cell-virus complex as a tool in the analysis of cell function.

The large number of papers on mitochondria and the size of the audience bore witness to the great interest in these cell structures. The discovery in recent years of their biochemical functions as complex enzyme systems was paralleled by the elucidation of their internal structure through the electron microscope. It was realized also that mitochondria are not all alike but that both within the same cell and between different cells there are distinct types. Better methods for separation of different particles were described and will lead to rapid progress in this field. Several investigators showed beautiful electron micrographs of the internal structure of mitochondria with their complex membrane systems, and it was natural to look for a relationship between this structure and the organized enzyme systems proposed by the biochemist. The static picture given by the electron microscope was healthily counterbalanced by some magnificent films of mitochondria in living cells. One was

impressed by the dynamic nature of the mitochondria continuously changing shape and position.

Among chromosomes the giant specimens in dipteran salivary glands and in amphibian oocytes received attention, especially with regard to visible expression of gene activity in modifications of structure along the length of the chromosome. It was evident that the detailed organization and significance of these chromosomes is not yet clear. In the past the electron microscope has not produced much information on chromosomes, but some progress has been made in studies which indicate that chromosomes of several plant and animal species consist of bundles of submicroscopic fibrils that are very similar in width in all species studied.

Nuclear growth is either the result of polyploidy, which leads to stepwise increase in the desoxyribonucleic acid content, or is an expression of metabolic changes that lead to increase in protein content without chromosomal reproduction, a fact neglected in earlier karyometric studies. Nuclear volume measurements, to be meaningful, must be accompanied by cytochemical studies. The nucleolus was reported to contain a self-reproducing coiled fiber, and evidence for the extrusion of material from nucleoli into the cytoplasm in living cultured cells was presented.

The division of a cell is a very complex series of reactions. Various chemicals that inhibit one or the other of the essential steps in mitosis (mitotic poisons) were again shown to be useful tools for the causal analysis of cell division. One must distinguish between agents that destroy mitotic organelles (for example, the spindle) and others that interfere with some essential metabolic step. Some of the well known antimetabolites can be reversed in their action by certain chemicals (for example, colchicine by adenosine triphosphate) and such studies help in finding out how these mitotic poisons act. The control of cell multiplication in morphogenesis has been little understood. It was thus interesting to hear of experiments on cultured rat liver cells which confirm some previous evidence that specific substances released from a tissue into the body fluids inhibit division in those cells. If these substances are removed from the environment the cells involved will multiply again.

The cell surface is an active complex structure. Its role in the passive and active movement of material in and out of cells was the topic of several papers. An instructive film of amoebas in motion demonstrated that these cells have a permanent contracting rear end which plays an important part in locomotion.

The most striking development in cell biology since the last congress was the increasing usefulness of the electron microscope in cell research. One can say that a new era of cell morphology has been opened that will link the world of the microscope with the world of molecules. The internal organization of long-known cell organelles has been revealed and the structure of the much-abused Golgi bodies is being clarified, but entirely new cytoplasmic units are also being discovered. The most interesting of these is the "ergastoplasm," cytoplasmic structures rich in ribonucleopro-

tein, which consist of a system of branched vesicles (endoplasmic reticulum) and opaque granules of the size of macromolecules. There is good evidence that this system functions in protein synthesis. It was described by several investigators in a large number of cell types. A survey of cytoplasmic organization in various tumors convinced many that the electron microscope is opening a new approach to the study of abnormal growth.

Another very active area in cell biology has been the qualitative and quantitative chemical analysis of cell components. A large number of papers described new methods and refinements of existing ones. Extremely small quantities of material can be extracted from single cells and analyzed by absorption spectrophotometry and ionophoresis, or studied *in situ* by cytospectrophotometry, autoradiography or interference microscopy. Some of these methods can also be used on living cells and changes in certain materials can be followed for instance during the mitotic cycle.

The major purpose of such a meeting should be the critical discussion of controversial subjects and of work in progress, and the exchange of technical information and ideas. There was a general feeling that not enough time was allowed for organized discussion. Unfortunately it is the tendency of such meetings, especially if they get large, to spend more and more time listening to short papers on rapidly changing subjects, and less time on exchange of opinion. When three to four sessions on related topics have to be scheduled concurrently, it is an indication that the organization of the meeting needs to be changed. A few plenary sessions with reviews of the most active fields of research are useful to take stock. But the oral presentation of all the papers sent in is no longer desirable. A program committee should select papers that can serve as bases for good discussions and leave those that present straightforward data to be read by title. Some topics might profitably be organized as panel discussions. Many papers are best given in the form of demonstrations if enough space and time are set aside. This type of presentation was largely neglected at the congress.

HANS RIS

Department of Zoology,  
University of Wisconsin, Madison

The 8th International Congress for Cell Biology was held in Leiden, Holland, during the first week of September 1954. For those readers who may not know what the term *cell biology* covers, it may be explained that the earlier designation was *cytology*. At the 6th Congress of Cytology in 1947 it was decided to form an international society, affiliated with the International Union of Biological Sciences, and to give it the job of organizing future congresses. For reasons which are not quite clear the society was called the International Society for Cell Biology, and the congresses were styled from then onward, International Congresses of Cell Biology.

The 8th congress had some features of organiza-

tion that are well worth reporting. In the first place the majority of the members were lodged in a few hotels 20 min by tram from Leiden, in the holiday resort of Noordwijk. This gave plenty of opportunity for members to meet one another. The price of the hotels was high, which made things not too easy for those who were neither guests of the congress nor representatives of some organization. Apart from this financial shortcoming, the arrangement was just of the kind required for maximum informal contacts and discussion.

The meetings were organized on a somewhat novel pattern. There were three or four symposiums per day. The chairman of each symposium would deliver in the morning a paper, unfortunately not followed by discussion, to the congress in joint sessions. In the afternoon the symposiums constituted themselves into separate sessions of the congress, with one medium-sized paper by the "moderator" and other 15-min papers offered by members. This organization insured that individual members, not having the gift of ubiquity so necessary in present-day international congresses, could at least listen to the chairmen's papers in the morning. Some of these chairmen's papers were of high quality and gave to members in other fields a good bird's-eye view of a particular topic. Others were too specialized and, therefore, defeated the purpose of this otherwise excellent arrangement. The works of the sessions were just as miscellaneous, both in quality and content, as can be easily gathered from the ill-defined term *cell biology*. In fact, there are no fields of either biology or medicine that were not in some way touched upon by the congress: from induced enzyme synthesis to nuclear and chromosome structure; from viruses to active cell surfaces; from mitotic poisons to electron microscopy; from immunology to tissue culture. Cytochemistry and histological techniques came in, of course, at all possible levels.

This congress poses very clearly again the question of whether such gatherings will serve a useful purpose. Perhaps at no other congress was the answer as clear as here. They serve very little purpose of the kind that meetings of scientific societies, or small working conferences, try to fulfill. Most of the innumerable rushed and short papers would have been much better published in the usual way and read at leisure. On the other hand, in these times of increasing specialization, these meetings serve an extremely useful purpose in permitting contacts among people living far apart and engaged in diverse but related fields. Members who attended the Leiden congress have profited from it in inverse proportion to the number of afternoon meetings that they attended. The morning joint sessions were usually valuable for everybody. In the afternoon meetings there were few who could profit by listening to more than perhaps two papers. The value of future congresses of this kind will be judged exclusively on the basis of how much informal contact they have promoted.

The social activities of the congress struck just the

right balance between generous hospitality and over-taxing the stamina of members. The atmosphere was throughout extremely cordial. The highlight of the social events was a magnificent reception given by the Netherlands Government in the Rijksmuseum in Amsterdam, where members had the opportunity to admire its permanent treasures and an outstanding exhibition of Indonesian art.

The Dutch hosts, and particularly their president, P. G. Gaillard and their secretary, W. H. K. Karstens, can be rightly proud for a congress that has, more than many others, succeeded in promoting a large amount of cross-fertilization.

G. PONTECORVO

*Genetics Department, The University,  
Glasgow, Scotland*

### AAAS Socio-Psychological Prize

Through the generosity of an anonymous donor, the AAAS offers an annual prize of \$1000 for a meritorious essay in socio-psychological inquiry. The conditions of competition for the prize to be awarded at the 1955 annual meeting, Atlanta, Georgia 26-31 December, are as follows:

1) The contribution should further the comprehension of the psychological-social-cultural behavior of human beings—the relationships of these hyphenated words being an essential part of the inquiry. Whether the contributor considers himself to be an anthropologist, a psychologist, a sociologist, or a member of some other group is unimportant, as long as his essay deals with basic observation and construction in the area variously known as social process, group behavior, or interpersonal behavior. For ease of reference in the rest of this statement, this general area will be called *social behavior*.

2) The prize is offered to encourage studies and analyses of social behavior based on explicitly stated assumptions or postulates, which lead to testable conclusions or deductions. In other words, it is a prize intended to encourage in social inquiry the development and application of dependable methodology analogous to the methods that have proved so fruitful in the natural sciences. This is not to state that the methods of any of the natural sciences are to be transferred without change to the study of social behavior, but rather that the development of a science of social behavior is fostered through observation guided by explicit postulates, which in turn are firmly grounded on prior observations. It may be taken for granted that such postulates will include a spatial-temporal framework for the inquiry. It may properly be added that the essay should foster liberation from philosophic-academic conventions and from dogmatic boundaries between different disciplines.

3) Hitherto unpublished manuscripts are eligible, as are manuscripts that have been published since 1 January 1954. Entries may be of any length, but each should present a completed analysis of a prob-

lem, the relevant data, and an interpretation of the data in terms of the postulates with which the study began. Preference will be given to manuscripts not over 50,000 words in length. Entries may be submitted by the author himself or by another person on his behalf.

4) Entries will be judged by a committee of three persons considered well qualified to judge material in this field. The judges will be selected by a management committee consisting of the vice president and secretary of Section K and the administrative secretary of AAAS. The Committee of Judges reserves the right to withhold the prize if no worthy essay is submitted.

5) Entries should be sent to Dael Wolfe, Administrative Secretary, American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington 5, D.C. Entries should be submitted in quadruplicate. The name of the author should not appear anywhere on the entry itself but should be enclosed on a separate sheet of paper which also gives the author's address and the title of his essay. To be eligible for consideration for the prize that will be awarded at the 1955 annual meeting of the Association, entries must be received *not later than 1 September 1955*.

### Science News

Gerard P. Kuiper, an astronomer who is associated with the University of Chicago's Yerkes Observatory (Wis.) and with the McDonald Observatory (Tex.), has established that the *pole of rotation of Venus* is tipped at an angle of  $32^\circ$  to its path, compared with the earth's  $23.5^\circ$ . Further, Kuiper's observations indicate that a day on Venus, one rotation upon its axis, is not almost a year of earthly time, as some textbooks estimate, but probably not more than a few weeks. He believes that this rapid rotation is shown by the daily changes that occur in the dark and light bands with which the planet is covered. The bands, usually three bright ones and three dark ones, are thought to be parallel to the equator of Venus.

Kuiper's research was conducted with the aid of the 82-in. telescope at McDonald Observatory, which is operated jointly by the University of Chicago and the University of Texas. Details of the work are reported in the November 1954 issue of the *Astrophysical Journal*.

Navajo Indians escape coronary thrombosis, which kills nearly 0.5 million persons per year in the United States. According to a study by Jarvey Gilbert of Burbank, Calif., who practiced on the Navajo Reservation, no proved case of the disease was found among 10,267 admissions to the Navajo Medical Center general hospital, Fort Defiance, Ariz., during the period 1949-52. During the same period, St. Joseph's Hospital in Albuquerque, N.M., approximately 150 mi away, reported 146 cases of coronary thrombosis among 20,289 admissions.

A chemical that makes cells divide has been isolated in pure crystalline form by a research group at the University of Wisconsin. Carlos Miller and Folke Skoog of the botany department and Malcolm von Saltza and F. M. Strong of the department of biochemistry have named the compound kinetin. It has a molecular weight of only 215, and its chemical formula indicates that the molecule contains 10 atoms of carbon, 9 of hydrogen, 5 of nitrogen, and 1 of oxygen. Kinetin is obtained from desoxyribonucleic acid.

When just a trace of the new substance—as little as 10 parts in 10<sup>6</sup> million parts of other matter—is added to culture mediums for plant tissue cells that are long past the growth period, the cells divide and new cells continue to be formed indefinitely so long as kinetin is in the medium. The first signs of growth usually show up within 3 to 5 days. When the rejuvenated tissues are placed in another medium that lacks kinetin, they stop growing. In order that continuous growth occur, the hormone auxin must also be added to the medium. Similar effects of cell division have been obtained with extracts from both plant and animal sources, including herring sperm, calf thymus glands, brewer's yeast, malt, and coconut. The work was supported by the American Cancer Society, the Wisconsin Alumni Research Foundation, and the National Science Foundation.

The possibility of radioactive contamination of public water supplies from the use of nuclear weapons or from improper disposal of waste from atomic reactor installations, research organizations, or hospitals has intensified investigations of methods for dealing with such contamination. Removal of radioactive contaminants from water by ion-exchange slurry is among the latest of these methods tested by the Sanitary Engineering Branch of the Corps of Engineers Research and Development Laboratories, Fort Belvoir, Va.

The method consists in removing the radioactive contaminants from the water by the addition of commercially available ion-exchange resins. Attracted to the resins, the radioactive ions settle out with them after the solution has been agitated. Tests in laboratory jars indicated that under certain conditions the ion-exchange batch slurry treatment decontaminates radioactively contaminated water to a level suitable for emergency drinking purposes within 30 min.

The Air Weather Service of the U.S. Air Force has reported that last year its reconnaissance squadrons flew 57,573 hr, the equivalent of more than 6.5 yr, tracking and reporting weather over a sizable part of the globe. The data compiled is used by the U.S. Weather Bureau and by international meteorological organizations.

A new radiochemistry laboratory that will, for the first time, produce and maintain national standards of artificially produced radioactive hydrogen has been established by the National Bureau of Standards. The laboratory will also facilitate the production on a large scale of standard samples of other radioactive

elements such as carbon-14, sodium-22, phosphorus-32, iodine-131, and gold-198. Another function of the new unit will be the development of the first national standard of tritium, a radioactive isotope of hydrogen that is widely used as a tracer in basic research and development work.

A statement issued by participants in a Soviet conference of publishing and printing workers that appeared on 20 Feb. in *Izvestia* criticized everything from the poor quality of Soviet paper to the dullness of Soviet fiction. It demanded, among other things, that scientific works be brought up to date and that more attention be given to the scientific achievements of other countries.

The report also stated that twice as many books were published last year as in 1940. The output was said to include 130 million copies of political publications, 234 million scientific and technical works, 259 million textbooks, 118 million volumes of fiction, and 117 million children's books.

Harold W. Pfautz of Brown University, chairman of the Committee on Freedom and Responsibility in Research and Teaching of the Eastern Sociological Society, has made public a statement by his committee that includes the following comments:

Along with other fields of research and teaching, sociology has become increasingly subject to and aware of dangerous threats to that intellectual freedom which is essential to the discharge of its professional responsibilities. As a discipline which seeks to understand human behavior in society, sociology has a clear and special responsibility strongly to reaffirm the basic right and need of men to know the conditions of their existence. . . . Anything which hampers the freedom to pursue scientific investigation, or distorts the public's understanding of the aims of social science, does a major disservice to the advancement of knowledge. There can be no "iron curtain" of forbidden inquiries in social science when such knowledge is basic to social welfare.

Freedom in research and teaching, therefore, is not a privilege conferred upon scientists and scholars for their sake, but a responsibility imposed on them for society's sake. . . . The sociologist must stand with his fellow scholars and scientists and with the informed public to maintain the social and political conditions requisite for increasing our knowledge of society. To do less would be to betray the ideal of professional responsibility which is the basis of his training. . . . Therefore, as one of many professional organizations of social scientists, the Eastern Sociological Society strongly affirms its support of academic freedom. By the same token, it protests against current abuses of legislative investigatory powers and their arbitrary interference with the essential work of our educational and research institutions. The Society will support its members in their right and obligation freely to study, speak, and write on all types of social issues. It invites all other groups similarly devoted to the preservation of individual freedom and responsibility and the advancement of knowledge to join in this common cause.



The 14th annual **Science Talent Search**, conducted by Science Clubs of America through Science Service, for high-school seniors was concluded 28 Feb. at a banquet at the Hotel Statler in Washington, D.C. Frederick P. Greenleaf of Allentown, Pa., whose interest is electrical engineering, and Kathleen A. Hable of Loyal, Wis., whose interest is medicine, won the two major scholarships awarded by the Westinghouse Educational Foundation [*Science* 121, 286 (25 Feb. 1955)].

Donald A. Quarles, Assistant Secretary of Defense (Research and Development), was the main speaker at the banquet. Quarles pointed out that the need for scientific personnel in the most important areas—education and basic research, industry, and military research and development—is critical and that our system of supply of scientific and technical manpower needs a critical reexamination. The problem confronts us on local and state levels in the need for more and better trained science teachers; on the national level in the need for adequate defense in an age when nucleonics, aeronautics, and electronics have revolutionized warfare, and when our rivals who support a different system are extremely conscious of the need for a highly developed technology and highly trained scientific manpower.

## Scientists in the News

**F. W. G. White**, chief executive officer of the Commonwealth Scientific and Industrial Research Organization, Australia, is spending 6 wk in Egypt under the aegis of the UNESCO technical assistance program to advise on the organization of Egyptian scientific research.

**Walter Clay Lowdermilk**, consultant to the United Nations on economic development, left in February for Tel Aviv, Israel. He has been invited to head the new department of agricultural engineering at the Israel Institute of Technology and to serve as consultant to the Government of Israel for a period of at least 6 mo. He is a specialist in soil and water conservation.

At the meeting of the American Academy of Orthopaedic Surgeons on 3 Feb., **Charles Weer Goff** was awarded the annual prize of a certificate of merit and \$1000 for the best research in orthopedics during the past 3 yr. The award is supported by Kappa Delta, a national women's sorority. Goff was honored for work on the disorders and disturbances affecting growing centers of bones in children and young people. His research was conducted in Hartford, Conn., in association with Yale University, where Goff is an assistant clinical professor of orthopedic surgery.

**W. Kenneth Davis**, acting director of the Atomic Energy Commission's division of reactor development since the resignation of Lawrence R. Hafstad on 1 Jan., has been appointed director.

**Felix Bloch**, Nobel prize winner in physics of Stanford University, who a few months ago accepted the directorship of the European Center for Nuclear Research in Geneva, has asked to be relieved of his duties there. He wishes to be free of his complex administrative responsibilities so that he may return to scientific work. Twelve western European governments are sponsoring the center, the first joint project for large-scale nuclear research. Bloch will be succeeded on 31 Aug. by **C. J. Bakker**, professor of physics at the University of Amsterdam, who is at present a member of the organization's directorate and a director of the synchrotron division.

**Melvin Calvin**, director of the bio-organic division of the University of California Radiation Laboratory and an authority on photosynthesis, has been chosen to present the 1955 Edgar Fahs Smith memorial lecture, which is sponsored jointly by the American Chemical Society's Philadelphia section and the University of Pennsylvania. He will speak on "The photosynthetic cycle" on 17 Mar. at the Museum of the University of Pennsylvania.

**Henry R. Mahler**, assistant professor at the Institute for Enzyme Research, University of Wisconsin, has been appointed associate professor of chemistry at Indiana University, effective in September.

**Irwin C. Gunsalus**, professor of bacteriology at the University of Illinois, Urbana, has transferred to the department of chemistry where he will head the division of biochemistry.

**Bruno J. Zwolinski**, senior physicist for the Stanford Research Institute, has taken a leave of absence to assist for 2 yr in the administration of the National Science Foundation's chemistry program.

**Bartholomew W. Hogan**, rear admiral, U.S. Navy, who entered the Navy Medical Corps in 1925, was sworn in as the new Surgeon General of the Navy on 15 Feb. Since last April he has served as deputy and assistant chief of the Navy Bureau of Medicine and Surgery, Washington, D.C.

**Peter M. Millman**, former chief of the stellar physics division of the Dominion Observatory, has joined the staff of the National Research Council of Canada as head of the section on upper atmosphere research in the Division of Radio and Electrical Engineering.

**Rhodes W. Fairbridge**, former lecturer in geology at the University of Western Australia and in 1953 a visiting professor at the University of Illinois, has been appointed professor of geology at Columbia University. He succeeds **A. K. Lobeck**, who has retired.

**Nicola Abbagnano**, professor of philosophy at the University of Turin, Italy, was a guest at the University of Texas Medical Branch, Galveston, during January. He gave a series of lecture and seminar discussions on "Contemporary philosophy in relation to medicine and science."

**J. B. Blizzard**, formerly a nuclear physicist at the University of Connecticut, has joined the staff of the New England Institute for Medical Research in Ridgefield, Conn.

**Karl B. McEachron, Jr.**, project engineer at the General Electric Co.'s Appliance Park, Louisville, Ky., has been appointed dean of undergraduates of Case Institute of Technology, effective 1 June. He will assume a portion of the duties now fulfilled by **Elmer Hutchisson**, who has been dean of the faculty since 1945. Hutchisson will devote full time to his responsibilities as dean of the Graduate School and director of research.

**James A. Krumhansl**, former associate professor of physics at Cornell University, has been appointed assistant director of research for the new research laboratories of the National Carbon Co., Cleveland, Ohio, a division of Union Carbide and Carbon Corp. His research has been primarily in solid-state physics, which, with related topics in chemical physics, will constitute a continuing interest.

The Landsverk Electrometer Co., Glendale, Calif., manufacturers of instruments for the measurement of radioactivity, has announced the appointment of **Don L. Collins** as vice president. Collins has been technical director of the Victoreen Instrument Co. since 1946.

**Isidor S. Ravdin**, professor of surgery at the University of Pennsylvania, has been promoted from brigadier general to major general in the U.S. Army Medical Corps Reserve. This is the first promotion to this rank ever to be achieved by a Medical Corps officer on inactive duty.

## Necrology

**Leo M. Christensen**, 56, chemical research engineer, former assistant professor of chemistry at Iowa State College of Agriculture and Mechanic Arts, Ames, 10 Feb.; **Frederick W. Dences**, 78, authority on structural steel engineering, retired assistant division engineer of the American Bridge Co., Chicago, 11 Feb.; **William F. Gordon**, 82, otolaryngologist, former associate professor of diseases of the ear at Columbia University School of Medicine, New York, 10 Feb.; **David S. Jacobus**, 93, former president of the American Society of Mechanical Engineers, inventor, former instructor in experimental mechanics and engineering physics at Stevens Institute of Technology, Hoboken, N.J., 11 Feb.; **E. Russell Lloyd**, 72, consulting geologist, formerly with the U.S. Geological Survey, Midland, Tex., 14 Feb.; **John Lloyd**, 91, retired engineer, inventor of the Wyoming steam eliminator, Wilkes-Barre, Pa., 11 Feb.

**Lawrence Martin**, 74, cartographer, former professor of geography at the University of Wisconsin, authority on glacial studies in Alaska, author, former chief of the Map Division of the Library of Congress,

Washington, D.C., 13 Feb.; **William D. Merrell**, 85, emeritus professor of botany at the University of Rochester, Rochester, N.Y., 11 Feb.; **Mortimer A. Munn**, 84, former engineering consultant with the Standard Oil Co., Cleveland, Ohio, 11 Feb.; **George S. Phipps**, 48, metallurgical specialist with Bell Telephone Laboratories, Murray Hill, N.J., 16 Feb.; **Robert E. Schluter**, 82, authority on medical history, former associate professor of surgery at St. Louis University Medical School, St. Louis, Mo., 12 Feb.; **Alonzo H. Stewart**, 87, former instructor in clinical microscopy and bacteriology at the University of Pennsylvania, Philadelphia, 13 Feb.; **John F. Wallace**, 62, airplane parts designer and builder, Cleveland, Ohio, 13 Feb.

## Meetings

**Man's Role in Changing the Face of the Earth**, an international symposium to be held 16-22 June at the Princeton Inn, Princeton, N.J., is announced today by the Wenner-Gren Foundation for Anthropological Research.

The symposium theme is intended to provide a basis for exploration of the question: What has been, and is, happening to the earth's surface as a result of man's having been on it for a long time, increasing in numbers and skills unevenly, at different places and times? It is felt that this subject is basic for obtaining perspective on the story of mankind. This story may be considered as man's own exploration of the various physical and biological conditions on the earth's surface as a result of the elaboration of human needs, capacities, aspirations, and values.

Three interrelated factors are involved: (i) the earth's resources; (ii) the numerical pressure of population upon, and sustained by, the resources; and (iii) man's differing cultures, or ways of life. Understanding these relationships involves knowledge of values, equipment and artifacts, and the social organizations by which people group themselves, function, and interpret resources and their use. Cultural development may be viewed as man's growing knowledge of, and control over, forces external to himself. By increasing his range of action, man has intervened more and more in the rest of the organic world. Man's evolutionary dominance is assured—only he himself can threaten it. Man has supplemented organic evolution with a new method of change—the development of culture, the transmission of organized experience, retained, discarded, or altered by further experience.

The symposium is intended to provide a focus of interest for persons with different theoretical and descriptive backgrounds. It is an attempt to survey the state of knowledge on a topic touched only in piecemeal fashion by individual disciplines. Emphasis is to be placed on the stimulation of cross-disciplinary thought.

Fifty-two background papers, each reviewing an aspect of the general theme and outlining problems

for future research, will provide the bases for discussion. The scope of the papers is indicated by the following outline of the general topics. (i) *Retro-spect*: man's tenure of the earth; through the corridors of time; (ii) *Process*: man's impact on the sea; changes in water economy; soil and slope changes through human use; modifications of biotic communities; ecology of wastes; urban-industrial demands on the land; (iii) *Prospect*: limitations of the earth; role of man.

Participation in the symposium is limited to 80 invited scholars, of whom 17 are from outside the United States. All the background papers will be pre-published and circulated for study in advance. The symposium will meet for six working days, on each of which two 3-hr sessions are to be held. The sessions are wholly for discussion; no papers are to be read. The chairmen of these half-day sessions include Edgar Anderson, Alan Bateman, Marston Bates, Harrison Brown, F. Fraser Darling, Lewis Mumford, Carl O. Sauer, Paul B. Sears, Alexander Spoehr, and Joseph B. Willits.

The symposium was the idea of William L. Thomas, Jr., assistant director of research for the NSF, and was implemented by Paul Fejos, director of research. The plan was developed by the symposium cochairmen, Sauer, Bates, and Mumford, who selected the participants to be invited. The proceedings, which are to be published by February 1956, will be edited by Thomas and will contain not only the background papers but also a report based upon the discussions. The National Science Foundation, through a grant-in-aid-of-publication subsidy, is a collaborating sponsor.

The 2nd International Automation Exposition will be held 14-17 Nov. at the Chicago Navy Pier. Exhibitors will show instruments, automatic controls, electronic computers, control valves, automatic dimensional gages, automation devices, mechanical attachments on process machinery, special production machines, conveyors and lifts of all types, and other custom-made material-handling devices. For information write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, Pa.

The division of biochemistry, the chemistry department, and the department of physiological chemistry of the University of California, Los Angeles, are sponsoring a symposium on **Amino Acid Biogenesis and Protein Synthesis** to be held 18-19 Apr. The following addresses will be presented: "Biogenesis of aliphatic amino acids in microorganisms," Sidney Weinhouse, Lankenau Hospital Research Institute and Institute for Cancer Research; "Biogenesis of aromatic amino acids in microorganisms," B. D. Davis, New York University College of Medicine; "Biogenesis of amino acids in mammals," P. P. Cohen, University of Wisconsin; "Stereochemical factors in amino acid metabolism," Alton Meister, National Institutes of Health; "Transfer mechanisms," C. S. Hanes, University of

Toronto; and "Mechanism of protein synthesis," H. N. Christensen, Tufts College Medical School. All inquiries should be addressed to: M. S. Dunn, Dept. of Chemistry, University of California, Los Angeles 24, Calif.

The 33rd general meeting of the **International Association for Dental Research** will be held 18-20 Mar. at the Morrison Hotel in Chicago, Ill. During the past few years the diversity of the program at meetings of this association has attracted the interest of individuals in all fields of basic science—particularly chemistry, microbiology, anatomy, crystallography, metallurgy, and applied physics. Interested persons are invited to attend.

The 3rd annual scientific meeting of the **Houston Neurological Society**, to be held at the Texas Medical Center 18-19 Mar., is featuring a special symposium on **Hypothalamic-Hypophyseal Interrelationships**. Included in the list of nine participants are two foreign visitors: Geoffrey W. Harris, director of the Laboratory of Neurophysiology, Maudsley Hospital, University of London, England; and Pierre Gloor, research associate, Montreal Neurological Institute, Canada.

The Committee on Vacuum Techniques, Inc., invites the presentation of papers at the 2nd **Symposium on Vacuum Technology** to be held at the Mellon Institute in Pittsburgh, Pa., 7-9 June. The program will deal with equipment, instrumentation, fundamental developments in vacuum technology, standards, nomenclature, methods and techniques, and vacuum-system applications and processes. Those interested in presenting a paper should communicate with Mr. Rudy Koehler, Committee on Vacuum Techniques, Inc., Box 1282, Boston 9, Mass.

The 5th conference of the **International Society for the Study of Biological Rhythm** is to be held 15-17 Sept. at the Karolinska Institutet in Stockholm, Sweden. The principal themes are rhythmical phenomena in the nervous system; cybernetics; and rhythm and industrial medicine. For information, write to Prof. Ture Petrén, Karolinska Institutet, Stockholm 60.

The National Science Foundation is offering a limited number of travel grants to American scientists who wish to attend the meeting. Applications must be received by the foundation before 25 April.

A symposium on **Fundamental and Applied Advances in Chelate Chemistry** will be sponsored by the Polytechnic Institute of Brooklyn 29-30 Apr. in the Engineering Societies Building, New York, as a feature of its centennial year celebration, which is being conducted under the theme "Science, engineering, research for human well-being." Cooperating with the institute in the sponsorship of the meeting are the American Cyanamid Co., General Aniline and Film Corp., Geigy Industrial Chemicals, Chas. Pfizer and

Co., Inc., Versenes, Inc., Victor Chemical Works, and Monsanto Chemical Co. W. Conrad Fernelius of Pennsylvania State University is chairman of the symposium. Harry P. Gregor of the Polytechnic Institute is coordinator and will provide invitations to anybody wishing to attend. Advance abstracts will also be supplied upon request.

Experts from many fields will attend the 1955 **National Health Forum**, to be held in New York, 23-24 Mar. on the theme "Forecasting America's health." Roscoe P. Kandle is chairman of the forum, which will be conducted by the 49 national organizations that make up the National Health Council. The 1955 forum is a part of the council's 35th annual meeting, which will continue through 25 Mar.

A symposium sponsored by E. R. Squibb and Sons on **Recent Advances in the Use of ACTH, Cortisone and Hydro-cortisone in Veterinary Medicine** will take place at the Sheraton Plaza Hotel in Boston on 13 Apr. The symposium will include five sections: (i) physiology of the pituitary adrenal system; (ii) small-animal field uses of the hormones; (iii) research section on bovine ketosis; (iv) practitioner's panel on bovine ketosis; (v) question-and-answer period. The proceedings are open gratis to all interested veterinarians and scientists.

## Education

The department of marine science of the **University of Miami** calls attention to courses leading to a master's degree, with specialization in marine biology, oceanography, and fisheries. Rising interest in the various aspects of the science of the oceans has made it impossible to meet the demand for trained marine biologists, oceanographers, and fishery biologists. Interested students with a bachelor's degree in zoology, physics, chemistry, or related sciences should communicate with the Dept. of Marine Science, University of Miami, Coral Gables, Fla.

The General Electric Co. has announced that it is entering into a contract with **Washington State College** to study the installation of a swimming-pool-type nuclear reactor at the institution. The contract is the first phase of an over-all plan to have a reactor functioning at the college within 2 yr. Harold M. Dodgen is directing the Nuclear Reactor Project for the college.

The **Institute of Biology: For Teachers of College Biology** will be held at the University of Wyoming, 18 July-19 Aug. The theme will be "Expanding horizons in biology." The institute is sponsored by the National Science Foundation, which has made provision for 25 stipends of \$250 each for college teachers who wish to attend. The director will be William B. Owen, professor of zoology at the University of Wyoming, and the associate director will be Harry V. Truman of Denison University.

The primary purpose of this institute is to enrich the teaching of college biology. The program will feature guest lecturers, discussions, and conferences on (i) teaching general biology, (ii) teaching upper division courses, (iii) training of a college biology teacher, and (iv) field methods in biology. Emphasis will also be placed on laboratory demonstrations and a display of materials and equipment. Two weeks of the institute will be conducted at the University of Wyoming Science Camp in the Medicine Bow Mountains, where field exercises are to be stressed. Address inquiries to the director.

Boston College has announced a special intensive course in **modern industrial spectrography**, 11-22 July. The course is particularly designed for chemists and physicists from industry who desire to learn the techniques of emission spectroscopy as an analytic tool. An optional third week of laboratory practice will be made available. Information may be obtained from Prof. James J. Devlin, S.J., Physics Dept., Boston College, Chestnut Hill 67, Mass.

Work on a nuclear reactor and the structure to house it will begin soon at the **University of Michigan**, and completion is expected in the spring of 1956. The building will be an extension of the north end of the Phoenix Memorial Laboratory now being erected on the university's new North Campus. The windowless, three-story addition and reactor will be financed from a grant of \$1 million made by the Ford Motor Company Fund to the Phoenix Project, the university's research program on the peacetime uses of atomic energy.

Initial operation of the reactor will be at an average power of 100 kw for 8 hr, with a peak of 1000 kw. This will provide the most intense source of neutrons and gamma rays that is operated by a nongovernmental agency and that is also open to scientific and industrial research on an unclassified basis.

## Available Fellowships and Awards

The **Philadelphia College of Pharmacy and Science** is offering graduate assistantships in pharmacy for 1955-56. The term of service is 9 mo with a maximum teaching load of 12 hr/wk. Each assistant receives a stipend of \$1000; tuition and all other fees are remitted. Men or women who have been granted the B.S. degree in pharmacy by a college of pharmacy accredited by the American Council on Pharmaceutical Education are eligible for appointment.

Graduate assistants may enroll in the graduate school in curriculums leading to the M.S. or Ph.D. degree in pharmacy and may major in pharmacy, pharmacology, pharmaceutical chemistry, or biological sciences. A partial schedule of studies, approximating two-thirds the full-time assignment, may be carried. The assistant will require two academic years to qualify for the M.S. degree.

Fellowships are available also to those who are



interested in graduate training in hospital pharmacy. Fellowship applications must be received by the college no later than 15 Apr. For further information, write to: Secretary of the Graduate Committee, Philadelphia College of Pharmacy and Science, 43rd St., Kingsessing and Woodland Avenues, Philadelphia 4, Pa.

The Audio-Visual Center at Indiana University has available for the coming academic year several graduate assistantships and part-time appointments for students who wish to take graduate work in audio-visual education and who have a particular interest in science and science teaching at elementary, secondary, and adult levels. Stipends range from \$900 to \$2400, depending upon the amount of time devoted to work activities. For information write to L. C. Larson, Director, Audio-Visual Center, Indiana University, Bloomington, Ind.

The ElectroData Corp. of Pasadena, Calif., manufacturers of the Datatron, has announced its 2nd annual university scholarship program in computers, 7 June-2 Sept. The financial-aid program, for students selected from leading universities, will comprise training in the structure and operation of digital computers, practical numerical analysis, the theory of programming and coding, industrial computer applications, and management of computer companies.

Records of no more than two students from any one university should be submitted before 15 Apr. Address applications to Dr. Paul Brock, ElectroData Corp., 717 N. Lake Ave., Pasadena, Calif. For each student selected to attend the course, ElectroData will grant \$500 to the individual's university.

The College of Forestry of the State University of New York expects to offer 25 assistantships for the college year 1955-56. Stipends vary from \$900 to \$1350 for 9 or 12 mo. Assistantship holders are excused from paying tuition and laboratory fees of about \$350 per year.

Recipients are required to assist in teaching and research work for a maximum of 15 hr/wk. Income derived from assistantship awards is subject to Federal income tax. Assistants may pursue studies leading to the master of forestry, master of science, and doctor of philosophy degrees. They may specialize in a number of fields related to forestry.

Specially qualified applicants will be considered for fellowships of from \$1500 to \$2000, sponsored by industry, research foundations, and Government agencies, that are awarded by the college for work on assigned research projects. Recipients are required to devote full time, except for course work, to these projects. Conditions of awards vary with sponsorship. Holders of these fellowships are also excused from paying tuition and laboratory fees. These fellowships are usually offered in such fields as wood chemistry, polymer and plastics chemistry, pulp and paper technology, wood technology and utilization, wood preservation, and pathology.

Research fellowships are also awarded in relation to the general program of research of the college and cover all the fields of forestry that are offered. Applications for 1955-56 should be made immediately. Detailed information may be obtained from the Chairman of Committee on Graduate Study, State University College of Forestry, Syracuse 10, N.Y.

## In the Laboratories

The Battelle Institute, Columbus, Ohio, has awarded to the American Machine and Foundry Co., New York, a contract for the design, engineering, and construction of a nuclear reactor. The reactor will be modeled after the bulk shielding reactor at the Oak Ridge National Laboratory and will be used primarily to provide an intense source of neutrons and atomic radiation for research uses. According to H. R. Nelson, manager of Battelle's department of physics and in charge of their new atomic research laboratories, the reactor will be designed to operate at 1000 kw on uranium-235 fuel. Together with auxiliary equipment and the building in which it will be housed, the reactor will cost an estimated \$0.5 million and is slated to begin actual operation 1 Feb. 1956.

The Diamond Ordnance Fuze Laboratories in Washington, D.C., established in 1953 as a research and development installation under the Ordnance Corps, Department of the Army, has issued a call for trained scientific personnel. Positions are currently open for electronic scientists, physicists, and mechanical and electronic engineers; salaries range from \$3410 to \$8360. Interested applicants may write to L. P. Conners, Civilian Personnel Office, Diamond Fuze Laboratories, Washington 25, D.C.

Corning Glass Works has announced the establishment of five new departments within its research and development division. Senior research associates whose present activities have been expanded by appointment to new positions are Howard R. Lillie, manager of fundamental research; Edwin M. Guyer, manager of electric glass working; John H. Munier, manager of photosensitive product development; George W. McLellan, manager of general product development, and James K. Davis, manager of electronic product development.

Plans to build new jet engine research and development plants costing more than \$12.5 million have been announced by the Westinghouse Electric Corp. The new facilities, which include both high- and low-power laboratories and an experimental engineering shop, will be located at the present site of the jet engine plant south of Kansas City, Mo., which Westinghouse leased from the Navy in 1948. A portion of the more than 230,000-ft<sup>2</sup> laboratory will be made available within the confines of the existing 80-acre building. The fuel and testing laboratories will be constructed on sites adjacent to the present jet engine plant.

## Book Reviews

### *The Fundamentals of Electric Log Interpretation.*

M. R. J. Wyllie. Academic Press, 1954. x + 126 pp. Illus. \$3.60.

Electric well logging is a method that measures the naturally occurring potentials set up at varying depths in the drilling mud of a bore-hole and the electric resistivities of the rock formations penetrated. Because these quantities depend on the permeability, porosity, and interstitial fluid content of the subsurface formations, the electric log has become one of the chief tools of the petroleum geologist and engineer. Qualitatively, the log may be employed for the identification of sedimentary strata and their correlation from one well to the next and, in simple cases, for an evaluation of whether specific beds may contain oil or gas or water. Quantitative interpretation is, however, necessary for more complex situations and for determining more precisely the effective porosity of a rock and the nature and percentage of the fluids filling the pore spaces.

The small book under review presents in simple and clear language the basic principles underlying the quantitative aspects of the electric log. Part 1, "The theory of quantitative log interpretation," is a singularly clear exposition of the physics of the materials involved and of the basic equations used to obtain the data desired from electric logs. Part 2, "The practice of quantitative log interpretation," has an especially fine discussion of the spontaneous-potential curve.

Because he considers that the interpretation of conventional resistivity logs is well covered by the widely known Schlumberger Documents Nos. 3 and 4, the author's chapter on these logs is incomplete. This is to be regretted as the one weakness in what would otherwise be a well-nigh perfect elementary textbook.

Brief but adequate treatment is given to the newer logging techniques that employ current-focusing and contact devices and induction.

This book is highly recommended to all nonspecialists who use the electric log.

E. MENCHER

Department of Geology and Geophysics,  
Massachusetts Institute of Technology

*Los Trigos de la Ceres Hispánica de Lagasca y Clemente.* Ricardo Tellez Molina and Manuel Alonso Peña. Instituto Nacional de Investigaciones Agronomicas, Madrid, 1952. xii + 516 pp. Illus. + plates.

The basis for this study is the collection of 1800 herbarium specimens of the genus *Triticum* made early in the 19th century by two Spanish botanists, Lagasca and Clemente. Through analysis and revision, Molina and Peña have reduced the original 30 species and as many "races" to the modern concept of eight species and varieties according to Korniche's system.

The taxonomic treatment in Part Two (354 pp.)

comprises the major portion of this work and contains related data, transcriptions of the annotations, and locality notes. It is in effect a catalog of all the materials earlier developed by Lagasca and Clemente as the *Ceres española*.

The text is beautifully illustrated with 56 colored plates, drawn under the direction of Lagasca, and further documented with 96 photographs of the more controversial species and varieties. Part One and the appendixes provide a rich background of biographic information, pertinent not only to the lives of Lagasca and Clemente, but to their period and contemporaries. Much of this is scattered throughout the quarto volume as a series of 148 footnotes referring to botanists and other collaborators honored in new species or "races." Facsimile reproductions and photographs of historical implication are included.

This is a remarkably complete work and contains many of Lagasca's and Clemente's unpublished notes. The taxonomic effort and skill displayed by Molina and Peña are clearly indicated in the index of 35 pages to both synonymy and common names of the wheats of Spain. The appealing physical features are demonstrated in the clean topography, clear-cut font, and well-balanced format. The keys to species and varieties will make it useful to those interested in the genealogy of wheat. But the present emphasis on the origins of agricultural plants gives this volume added significance as a worth-while source of reference in the study of both economic and historical botany.

GEORGE A. LLANO

Research Studies Institute, Air University,  
Maxwell Air Force Base, Alabama

*Progress in Metal Physics.* vol. 5. Bruce Chalmers and R. King, Eds. Interscience, New York; Pergamon, London, 1954. vii + 324 pp. Illus. \$9.50.

The earlier volumes of *Progress in Metal Physics* will be familiar to all physical metallurgists. The subject matter covered by the series is broader than the title would suggest; it is doubtful whether any of the five articles in the present volume fall strictly within the domain of metal physics. However, I would certainly not register any complaint on this score.

The outstanding and longest contribution (135 pp.) to this fifth volume is the "Report on precipitation" by H. K. Hardy and T. J. Heal. The rival nucleation and fluctuation theories are critically reviewed, and their predictions are compared with the experimental data for some 10 different age-hardening alloys. The authors are to be congratulated on a lucid exposition of a notoriously involved subject.

Welcome additions are two articles dealing with the deformation of metals—a topic hitherto neglected in this series. Within the limits imposed by the title, "Geometrical aspects of the plastic deformation of

metal single crystals," R. Madding and N. K. Chen give an extensive discussion of the formation of slip lines and the slip systems in B.C.C., F.C.C., H.C.P., and other metal crystals. The article by N. J. Petch on "Fracture of metals" is less satisfactory. Some important contributions to this field are neglected, while undue emphasis seems to be placed on the author's own theory that associates Griffith cracks in metals with arrays of blocked dislocations.

The two remaining articles relate, respectively, to the solidification and structure of liquid metals. The former, by U. M. Martins contains an extensive summary of the data related to pure metals, but the segregation of alloys during solidification is only barely touched on. B. R. T. Frost gives a useful, if somewhat uncritical, review of the structure of liquid metals. The section of his article treating the thermodynamics of liquid alloys is too sketchy to be of much value and contains an excessive number of small errors which will be irritating to the specialist and a source of confusion to the nonthermodynamicist.

The only general complaint I would make is that the value of some of the contributions would have been enhanced by the inclusion of a summary either at the end or beginning of each article. Otherwise, the presentation and typography maintain the very high standard set by the previous volumes. An excellent name and subject index is included.

JOHN E. HILLIARD

Department of Metallurgy,  
Massachusetts Institute of Technology

**Modern Experiments in Telepathy.** S. G. Soal and F. Bateman. Yale Univ. Press, New Haven, 1954. xv + 425 pp. Illus. + plate. \$5.

The authors have presented a book intended for the purposeful reader and the student of parapsychology. Its primary purpose is to consider much of the available evidence concerning telepathy from the point of view of the scientific statistician. This purpose is admirably fulfilled by a careful résumé of the historical background and experimental approaches to paranormal happenings. As nearly as possible, the authors have attempted to confine themselves to extrasensory perception (ESP) in its relation to card guessing, basing their work on the assumption that "the validity of any piece of scientific research depends ultimately upon its confirmation by other investigators. . . ." They have assembled an impressive array of experiments and data, carefully evolved, minutely recorded, and, within limits, capable of reproduction by other investigators. In their endeavor to eliminate deception, fraud, and artifact, they have imposed extreme and, at times, absurd precautions.

A secondary theme of the book appears to be a refutation of those hypotheses that seek to explain the beyond-chance results of ESP experiments as being due not to telepathy or extrasensory perception but, instead, to artifacts or defects in our theory of probability. The evidence offered as rebuttal to these

hypotheses, however, is based chiefly upon statistics derived from the very probability theory under question. It seems that the reliability of such reasoning is unsound. More attention might well be directed not toward an evaluation of the mathematical accuracy of those statistics dealing with beyond-chance expectations but rather toward a determination of whether random distribution based upon these statistics actually behaves in practice as would be predicted by accepted probability theory.

The book provides, in addition to adequate testing techniques, a review of the hypotheses that seek to explain ESP, a summary of current research in the field, a correlation of parapsychology with the more orthodox sciences, and an insight into methods of statistical analysis. An extensive appendix, a bibliography, and a well-organized index enhance the usefulness of the book as a guide for those who wish to investigate or evaluate paranormal phenomena on a scientific basis.

W. O. RAMSEY

Dental School, University of Maryland

**Complex Variable Theory and Transform Calculus.** With technical applications. N. W. McLachlan. Cambridge Univ. Press, New York, ed. 2, 1953. xi + 388 pp. Illus. \$10.

This is a second edition of a work originally published in 1939 under the title *Complex Variable and Operational Calculus with Technical Applications*. In the preface to this new book, the author says, in speaking of the two editions:

. . . the degree of rigour seemed to be adequate, but certain pure mathematicians (and physicists!) who reviewed the book disagreed. In the interim, the standard of technical mathematics has improved, and it is now possible to be more rigorous than before. Accordingly the chapters on Complex Variable Theory have been rewritten, amplified, and made rigorous enough for all but the pure mathematician, to whom the book is not addressed.

This change in attitude toward mathematics is most welcome, although it would seem that there is still much room for improvement in the average electrical engineering article of the present day. Let us hope that McLachlan's colleagues will follow his lead.

Almost exactly one-half of the book is devoted to an exposition of certain portions of the theory of functions of a complex variable, particularly such topics as the calculus of residues, contour integration, operations with integrals, and transform theory. The second half deals with applications of these mathematical disciplines to a variety of technical problems drawn largely from electrodynamics and related fields. The more specialized applications include studies of the influence of gun recoil on the motion of an airplane, radio receiver circuits, various aspects of partial differential equations, loaded and unloaded cable circuits both with and without terminal apparatus, electric wave filters, condenser microphones, and loud-

speaker horns. At the end are a number of appendixes dealing with some of the items of mathematical interest noted in the text but not elaborated upon there, and a short list of transforms.

The particular transform employed in this work is the  $p$ -multiplied Laplace transform. It is largely a matter of personal taste whether the Laplace transform be used in its original form or with the additional  $p$  multiplier; but it is a pleasure to note that the author tags his choice of the  $p$ -multiplied transform with an explicit label. Accordingly, there can be no misunderstanding as to which transform is being used. He is also to be congratulated upon his use of it throughout for the imaginary unit, despite its avoidance by most electrical engineers of the present day.

McLachlan's book contains an excellent bibliography (273 items) and an unusually serviceable index. It seems to be very well printed, with the possible exception of some of the figures, where certain of the lines appear much too heavy for the size of the cut.

This second edition appears to be a marked improvement upon the earlier work. It is a noteworthy book in its field.

RONALD M. FOSTER

Department of Mathematics,  
Polytechnic Institute of Brooklyn

**The Coalfields of Great Britain.** Arthur Trueman, Ed. Edward Arnold, London; St. Martin's Press, New York, 1954. xi+396 pp. Illus.+plates. \$15.

This book is the first review of the state of knowledge in this subject since the 1927 revision of Walcot Gibson's *Coal in Great Britain*. Here is a condensed and elementary summary of the geologic theories and mechanisms of the laying down of coal beds and a series of chapters describing the history, present condition, and future prospects for the 11 major coal fields of England, Scotland, and Wales.

The editor is author of the first four chapters elucidating the present theories of the origin of coal, with special emphasis on fossils and geologic characteristics of the different seams that make it possible to correlate their occurrence and properties not only in Great Britain but across the English Channel as well.

The balance of the book consists of 11 chapters on the major fields, authored by nine geologists of universities and the Geological Survey. In a standardized systematic outline, they describe for each field the general historical background, the sequence of sedimentary rocks, and detailed characteristics and sequences of the major coal seams. Each chapter concludes with a brief estimate of the existing reserves and the future potential production. These condensed reviews are for reference and not for reading.

This book will be of particular interest to students and to industrial management who need a condensed and general review. It is a reference book for those who want to make a start in the study of a particular coal field. Those who need more detailed information will find the selected references of great value.

The coal industry of the United States, even though it is much younger, is already plagued by many of the troubles that stand out in this book. Records of workings are nonexistent or incomplete, and the correlation of mining and drilling information is not sufficient to allow accurate estimates of the quantity and quality of coal that can be recovered economically in the future. Today there are rapid developments in mineral exploration techniques, in mechanized mining, in coal cleaning, in coal utilization, and in the economics of competitive fuels. The interdependence of these factors makes even short-range planning difficult. This book makes its contribution in bringing together the scattered and incomplete knowledge in the sphere of the geologist and the mining engineer. Immense amounts of work remain to be done before the British (and we) know where and how much coal there is, and how it can be mined.

GEORGE D. CREELMAN

Creelman Associates, Cleveland, Ohio

**Endokrinologische Psychiatrie.** M. Bleuler. Georg Thieme, Stuttgart, 1954. xi+498 pp. Dm 46.50. (U.S. distrib., Intercontinental Medical Book, New York).

M. Bleuler explains (i) the description of psychic specific maladies in cases of endocrinological anomalies, (ii) the teaching of the interrelationship of endocrine and psychic conditions as they coexist in the same individual, or if they influence one another, and (iii) the teaching if and in what ways personality disturbances can be influenced by endocrinological means. He emphasizes the importance of the knowledge of endocrine *psychology*. Up to now the research has been based on pathologic conditions with the result of multa rather than multum. The endocrinologist should make his studies in the clinic of psychiatric patients and the psychiatrist in the workshop of the endocrinologist.

Bleuler's work consists of 380 original text pages, 117 pages of bibliography with 2717 references. Bleuler was guest scholar in the Endocrinological Clinic of the New York Hospital and the Payne-Whitney Psychiatric Clinic to observe the intimate cooperation between psychiatrists with specialists of other medical services. His statements are based on clinical experience, and it is surprising that he very often avoided projection techniques such as the Rorschach, thematic apperception test, Bernreuter test, Szondi, and others. I do not agree with disregarding a battery of tests. I agree with him in using them only as the basis for psychological examination and judgment.

The book is divided into two parts: psychopathology of the endocrine maladies and endocrinology of psychopathology. Bleuler draws the following conclusions: (i) Many schizophrenies are endocrinologically healthy. There is no uniform endocrine pathology for all schizophrenic diseases. (ii) The several endocrine disturbances are generally not accompanied by schizo-



phrenia. (iii) Some mild endocrine disturbances are found oftener in schizophrenics than in healthy persons. This is understandable if we realize that schizophrenia is genetically not a uniform pathologic documentation. The concept of schizophrenia includes psychological, sociological, and statistical constitutional facts.

In respect to therapy, Bleuler follows more or less the recommendation of French and English scholars by applying an individual hormonal therapy for psychotics in cases of endocrinal components in psychic diseases.

ALBERT REISSNER

Alfred Adler Consultation Center  
and Mental Hygiene Clinic, New York

**Diagnosis and Treatment of the Acute Phase of Poliomyelitis and Its Complications.** Albert G. Bower, Ed. Williams & Wilkins, Baltimore, 1954. x+257 pp. Illus. \$6.50.

Albert Bower, with 14 contributing authors, has assembled a most valuable book on the diagnosis and treatment of the poliomyelitis patient. It is important, first of all because it brings together in a single textbook material that up to now was widely scattered in the medical literature. He has done this by integrating the contributions from the various fields of radiology, anesthesiology, orthopedics, physical medicine, otolaryngology, and obstetrics into the general medical management of the patient. Second, the book is helpful because it presents the current methods of treatment that are the culmination of 25 years' experience in the care of more than 18,000 polio patients at the Los Angeles County Hospital. Bower, furthermore, presents these techniques in a simple, easily understood style with sufficient illustrations and detail to make them easily transferable to a house-officers' manual or a list of nursing procedures. And extrapolating from the Los Angeles County Hospital experience, in the last chapter, he suggests how this material can be applied by describing what "one small community" of Washoe County, Nevada, had done to meet the problem of poliomyelitis.

Although I have no serious criticism of this fine book, I wish that the list of contributing disciplines included psychiatry for help in the management of frequent emotional problems of the polio patient, problems well emphasized, by the way, in early chapters of the book. In this regard too, the contributions to the patient and physician of the social worker and the local chapters of the National Foundation for Infantile Paralysis could have been described. Likewise, pediatric emphasis seemed lacking in dealing with the disease in infants and young children, with whom a number of procedures highly recommended for adults seem impractical. One might wish as well for more detail on physical therapy. This chapter received only one-third of the space given to orthopedics, for example. Also, a considerable number of drugs were listed by proprietary names, thus lessening the use-

fulness of the book where it might be most helpful—in remote or foreign areas. There is an inherent danger in basing a book on a single group's experience, because evaluation of certain techniques (in this case the electrophrenic respirator) might be contrary to a more widespread opinion. But these minor criticisms should in no way detract from the book's value to doctors, nurses, physical therapists, health officers, and other groups interested in the problems of poliomyelitis today.

JOHN P. UTZ

National Institutes of Health, Bethesda, Maryland

**Television.** The electronics of image transmission in color and monochrome. V. K. Zworykin and G. A. Morton. Wiley, New York; Chapman & Hall, London, ed. 2, 1954. xv+1037 pp. Illus. \$17.50.

This book is an up-to-date revision of the well-known television textbook by these same authors published in 1940. Because of the rapid growth of the television field in the past decade, the original work had become somewhat of a museum piece, even though it contained much valuable material that has not found any counterpart in later textbooks. This latter fact has undoubtedly been responsible for the success achieved by it in continuing to hold its place as a leading source book on television theory and practice, even after the appearance of other books whose presentations reflected more fully the continuing development of television technology. It is therefore to be expected that a revised edition will be eagerly welcomed, especially in view of the fact that several new developments in the field had not yet been adequately treated in any existing textbook. Foremost among these is the advent of compatible color television.

In most respects, this revised edition will not disappoint those who hold high expectations for it. It retains that material from the earlier edition not given comparable treatment in more recent general television textbooks, and in some instances this material has been revised to take into account facts of very recent origin. Also, a great quantity of entirely new material has been added. Thus, semiconductors, color television, the new vidicon pickup tube, and modern refinements in picture display systems are discussed in considerable detail.

On the debit side, it must be noted that the new sections, particularly those on color television, show evidence of having been put together rather hastily. Some passages are worded in such a way that they are difficult to understand, and some of the diagrams contain errors. Finally, the subject index is so short in proportion to the total bulk of the book that its use leads mostly to frustration. However, these are all relatively minor objections. The book can be highly recommended as a good source of information on television theory and practice.

DONALD C. LIVINGSTON

Physics Laboratory,  
Sylvania Electric Products, Inc.

# Technical Papers

## Potential of Pentobarbital Anesthesia by Isonicotinic Acid Hydrazide and Related Compounds

Abraham Goldin, Don Dennis,  
John M. Venditti, Stewart R. Humphreys

Laboratory of Chemical Pharmacology,  
National Cancer Institute,  
National Institutes of Health, Bethesda, Maryland

During the course of investigating enzymatically catalyzed exchange reactions *in vivo* and their relationship to chemotherapy (1), it was observed that several of the congeners of nicotinic acid employed in antitubercular studies prolonged the anesthetic action of pentobarbital in mice.

The experiments were conducted with CDBA hybrid male mice, 10 to 12 wk old, weighing 20 to 25 g. Pentobarbital (Na) was administered intraperitoneally. All other drugs were administered subcutaneously. The drugs were administered at 1 percent body weight in a saline or water vehicle. The duration of anesthesia was measured as time elapsed from the loss of righting reflex to its return (2, 3).

An experiment in which the pentobarbital was administered 15 min after isonicotinic acid hydrazide (INH) is summarized in Table 1. It is evident, in the combination treatment, that the extent of pentobarbital anesthesia may be increased by increasing the dose of INH as well as by increasing the dose of pentobarbital. In other experiments prolongation of pentobarbital anesthesia was noted with doses of INH as low as 50 mg/kg (with 60 mg/kg of pentobarbital).

In the dose range employed (Table 1), INH elicits acute toxicity, characterized by tremors, convulsions, tetanic spasm, and respiratory arrest, in approxi-

Table 1. Protection against INH lethal toxicity by pentobarbital and prolongation of pentobarbital anesthesia by INH. The ratio represents mice dead/total. The numbers in parentheses indicate the mean anesthetic time in minutes plus or minus ( $\pm$ ) 1 standard error of mean.

INH (mg/kg)	Pentobarbital (Na) (mg/kg)				
	0	51.2	64	80	100
500	5/5 (0)	0/5 ( $> 420$ )	0/5 ( $> 420$ )	3/5 ( $> 420$ )	5/5
400	5/5 (0)	0/5 ( $322 \pm 29$ )	0/5 ( $> 420$ )	3/5 ( $> 420$ )	5/5
320	5/5 (0)	0/5 ( $201 \pm 42$ )	0/5 ( $401 \pm 6$ )	0/5 ( $> 420$ )	2/5 ( $> 420$ )
256	5/5 (0)	0/5 ( $240 \pm 24$ )	0/5 ( $397 \pm 6$ )	0/5 ( $> 420$ )	2/5 ( $> 420$ )
0		0/5 ( $46 \pm 2$ )	0/5 ( $67 \pm 1$ )	0/5 ( $116 \pm 5$ )	0/5 ( $123 \pm 8$ )

mately 30 to 60 min (4-6). Pentobarbital afforded protection against the acute toxicity of INH (Table 1), as did phenobarbital or chloral hydrate (4). This protective action was observed even when the pentobarbital was administered in the initial stages of convulsive seizure. At the lower doses of pentobarbital this protection was complete (Table 1). However, at the higher doses of pentobarbital, the potentiation of anesthesia was sufficiently extensive that animals succumbed without recovery, in a manner similar to that observed with an overdose of pentobarbital alone. Thus, the extent of potentiation of pentobarbital anesthesia by INH and the protection by pentobarbital against the acute toxicity of INH appear to be interrelated and to depend on the relative doses of INH and pentobarbital employed.

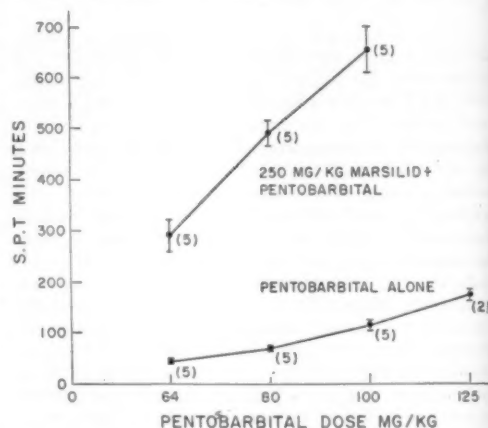


Fig. 1. Prolongation of pentobarbital anesthesia by Marsilid. "S.P.T. minutes" is the mean anesthetic time plus or minus ( $\pm$ ) 1 standard error of mean. Five mice per group; the number in parentheses indicates the number of survivors.

Prolongation of pentobarbital anesthesia was also observed with 1-isonicotinyl-2-isopropyl hydrazine phosphate (Marsilid). Marsilid alone induced neither convulsions nor anesthesia at doses up to 1500 mg/kg. In combination with pentobarbital, Marsilid appeared to induce more extensive anesthesia than any dose of pentobarbital alone (Fig. 1).

In addition to INH or Marsilid, prolongation of pentobarbital anesthesia has been observed in our laboratory with isonicotinic acid amide, nicotinic acid hydrazide, 3-acetyl pyridine, hydrazine hydrate, and glycine. The potentiation of the duration of the action of barbiturates has been observed to occur when other types of drugs (2, 3) are used, and of these  $\beta$ -diethylaminoethyl diphenylpropylacetic acid HCl

(SKF 525-A) has been reported to be highly effective (3). Although no quantitative comparisons were made, the prolongation of anesthesia in mice with INH and Marsilid appeared to be of the same order as that of SKF 525-A. Dimercaprol and SKF 525-A have been reported to inhibit the rate of biotransformation of pentobarbital in the body (2, 7). This has not been determined with respect to the action of drugs reported here.

Although both INH and Marsilid, when administered simultaneously with or prior (4 hr) to pentobarbital, in both cases prolonged anesthesia, they do not appear to act in an entirely similar manner. Marsilid (250 mg/kg) caused a significant reduction (40 to 50 percent) in the dose of pentobarbital required to induce anesthesia in 50 percent of the animals ( $ED_{50}$ ). With the same dose of INH, reduction of the  $ED_{50}$  was not significant (5 to 10 percent). This occurred even though at equivalent doses Marsilid is less toxic than INH. With a subanesthetic dose of pentobarbital (30 mg/kg), Marsilid (250 mg/kg) induced anesthesia while INH had no effect over a dose range of 50 to 400 mg/kg. Following recovery from pentobarbital (60 mg/kg) anesthesia, Marsilid (500 mg/kg) reinduced anesthesia, whereas INH (500 mg/kg) did not.

Also INH and 3-acetyl pyridine do not appear to act in an entirely parallel manner. Pentobarbital afforded protection against the toxicity of INH but did not protect against that of 3-acetyl pyridine. Nicotinamide did not protect against INH toxicity but did protect against that of 3-acetyl pyridine (1). The administration of nicotinamide or nicotinic acid did not result in any prolongation of anesthesia with pentobarbital.

Nicotinamide and pentobarbital do not appear to act antagonistically with respect to 3-acetyl pyridine. Protection by nicotinamide against the toxicity of 3-acetyl pyridine (1) did not appear to reduce the potentiating effect of the latter on pentobarbital anesthesia. Also, pentobarbital administration did not reduce the protective action of nicotinamide against 3-acetyl pyridine toxicity. However, nicotinamide metabolism has been implicated in the duration of action of barbiturates and in their metabolism (8-10).

Kaplan and Ciotti have observed an inhibition of diphosphopyridine nucleotidase activity by pentobarbital (11). The relationship of enzymatic transformations involving diphosphopyridine nucleotidases to the potentiation of barbiturate anesthesia and the observed toxicologic interrelationships is under investigation (11).

## References

1. N. O. Kaplan *et al.*, *Science* **120**, 437 (1954).
2. J. B. Kahn, Jr., *J. Pharmacol. Exptl. Therap.* **109**, 292 (1953).
3. L. Cook, J. J. Toner, and E. J. Fellows, *ibid.* **111**, 131 (1954).
4. J. F. Reinhard, E. T. Kimura, and R. J. Schachter, *Science* **116**, 166 (1952).
5. W. M. Benson, P. L. Steffen, and M. D. Roe, *Am. Rev. Tuberc.* **65**, 376 (1952).
6. B. Rubin, *ibid.* **65**, 392 (1952).

7. J. Axelrod, J. Reichenenthal, and B. B. Brodie, *J. Pharmacol. Exptl. Therap.* **112**, 49 (1954).
8. H. A. Levy, J. R. Di Palma, and C. Alper, *ibid.* **100**, 377 (1953).
9. F. E. Shideman, *Federation Proc.* **11**, 640 (1952).
10. J. R. Cooper, J. Axelrod, and B. B. Brodie, *J. Pharmacol. Exptl. Therap.* **112**, 55 (1954).
11. N. O. Kaplan and M. M. Ciotti, unpublished observations.

22 December 1954.

## Relationship of Hallucinogens to Adrenergic Cerebral Neurohumors

Amedeo S. Marrazzi and E. Ross Hart

Clinical Research Division and Neurology Branch,  
Chemical Corps Medical Laboratories,  
Army Chemical Center, Maryland

The study of cerebral synaptic transmission, by recording the postsynaptic electric response evoked by presynaptic stimulation, has demonstrated that an adrenergic synaptic transmission mechanism is present and capable of operating in the cat's brain. Marrazzi (1) has reviewed the evidence for this in a recent article in which he describes the use of the relatively simple transcallosal pathway connecting symmetrical points in the right and left optic cortex of the cat, thus making it possible to study one cortex when test stimuli are applied to the other. The electrocortical record so obtained indicates the activity at the terminal synapses by a surface positive wave corresponding to the inflow of impulses into the synapses and a surface negative wave indicating the outflow. In such a preparation, adrenaline, noradrenaline, and the so-called "adrenaline preservatives" cause a decrease in the surface negative wave generated by synaptic outflow without causing a change in the surface positive wave generated by the inflow—that is, a differential reduction in output or a synaptic inhibition.

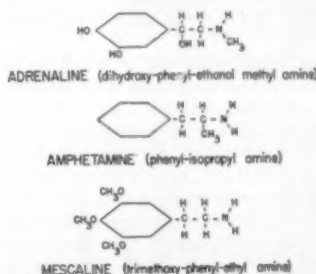


Fig. 1. Types of phenylethyl amines producing mental effects.

Because of the structural similarity (Fig. 1) between adrenaline, which occasionally causes mental disturbances in man, amphetamine, which does so more often, and mescaline, which is a powerful hallucinogen, it was decided to compare the effects of the three on cerebral synaptic transmission. We had al-

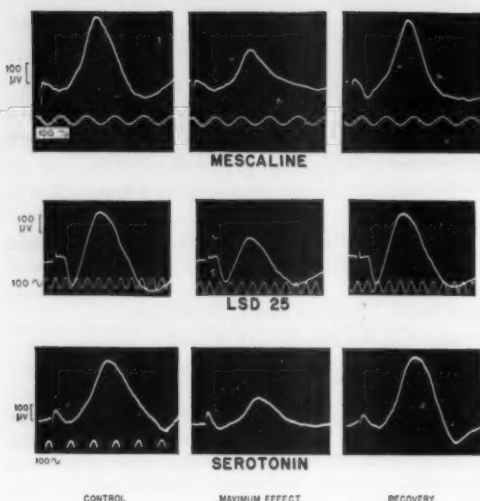


Fig. 2. Inhibition at cortical terminal synapses of transcallosal pathway in cat's brain. Potentials evoked in optic cortex of cat by electric stimulation of contralateral cortex. The drugs injected into carotid artery on recording side were mescaline, 15 mg/kg; lysergic acid diethylamide (LSD-25), 8  $\mu$ g/kg; and serotonin, 1  $\mu$ g/kg. Negativity is up. Sodium pentobarbital was used as the anesthesia.

ready shown that adrenaline and amphetamine, and other adrenalinelike compounds (2) produce cerebral synaptic inhibition in the cat. Figure 2 illustrates that the effects of mescaline on the synapses of the optic cortex of the cat are qualitatively identical with those of the other two members of the series. Thus, mescaline also produces a synaptic inhibition. It seems warranted to propose an empirical correlation between the synaptic inhibition and the disturbances in conduct observed on administration of mescaline to the unanesthetized cat and the marked hallucinations induced in man.

Additional similarities can be noted by comparing (Fig. 3) the chemical structures of adrenaline, adrenochrome—a possible breakdown product of adrenaline claimed to be capable of simulating schizophrenia (3)—and the very potent hallucinogen, lysergic acid diethylamide (LSD-25), as well as the chemical structure of serotonin, suggested by Woolley and Shaw (4) as the cerebral metabolite whose deficiency may be responsible for schizophrenia. The similarity between LSD-25 and serotonin is on the basis of the indole ring that they possess in common with adrenochrome, the possible metabolic product of adrenaline, through which the two series of hallucinogens examined are thereby linked.

The theoretical considerations advanced, as well as the suggestion that LSD-25 and serotonin might oppose each other's actions on the nervous system, made it logical to determine their effects on cerebral synaptic transmission in the brain of the cat, utilizing the

preparation discussed earlier. Figure 2 demonstrates that LSD-25 has qualitatively the same synaptic inhibitory action as mescaline and adrenaline. The same is true of serotonin (Fig. 2), except that it is about 6 to 8 times as potent as LSD-25 and about 25 to 30 times as potent as adrenaline. Thus, the suggestion, arising from structural similarities, that all members of these series would produce cerebral synaptic inhibition is borne out, while a cerebral antagonism between LSD-25 and serotonin is not found. Competition among the members of these series can be expected, but, since serotonin is far more potent than the others in producing the same kind of synaptic action (inhibition), it would hardly be expected to offset the others, and its deficiency could not reasonably be expected to lead to the same type of effects as those exercised by LSD-25.

The high potency of serotonin, which is in the same range as that for acetylcholine (1) on these synapses, and its reported natural presence in the brain (5) make one speculate concerning the possible role it might play in the natural function of the nervous system, possibly as a humoral inhibitor. The synaptic inhibitory action of serotonin in the gamma doses used is unaccompanied by any significant change in circulation, as indicated by blood pressure. There is, therefore, little or no basis for assuming changes in cerebral blood flow sufficient to interfere with synaptic transmission. Furthermore, the synaptic effects of anoxia are quite delayed, while that of serotonin is achieved within 30 to 40 sec, reaching a maximum in about 1 min and receding by 3 min. It is clear from the cerebral action of serotonin, introduced into the circulation, that serotonin must pass the blood-brain barrier, although the comparative rate is not established.

The actions described here for one group of synapses are probably typical of more generalized effects, since they have also been recorded at a variety of synapses for adrenaline and adrenalinelike compounds (1-2) and in the ciliary ganglion for serotonin (6). With generalized synaptic inhibition, the resulting pattern of over-all activity would be a func-

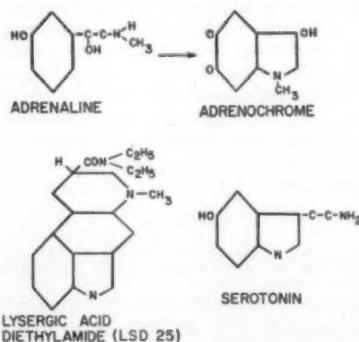


Fig. 3. Chemical structure of adrenaline, adrenochrome, lysergic acid diethylamide (LSD-25), and serotonin.



tion of the variations in synaptic thresholds. In this preliminary stage of correlation, an interpretation of hallucinations as stimulatory phenomena, rather than as derangements owing to partial inhibition, offers no real difficulty, since synaptic inhibition could readily result in release from normal restraining influences with consequent stimulation.

A disturbance of adrenergic or related cerebral neurohumoral mechanisms appears to be implicated in the actions of the hallucinogens studied. The resulting imbalance in the reciprocal relationship (1) between adrenergic inhibition and cholinergic excitation in the most susceptible cerebral synapses might be an underlying mechanism in mental disturbance.

#### References

1. A. S. Marraszi, *Science* **118**, 367 (1953).
2. E. L. Hart and A. S. Marraszi, *J. Pharmacol. Exptl. Therap.* **106**, 394 (1952); —, *Electroencephalog. Clin. Neurophysiol.* **5**, 317 (1953).
3. A. Hoffer, H. Osmond, and J. Smythies, *J. Mental Sci.* **100**, 29 (1954).
4. D. W. Woolley and E. Shaw, *Science* **119**, 587 (1954).
5. I. H. Page, *Physiol. Revs.* **34**, 563 (1954).
6. I. H. Page and J. W. McCubbin, *Circulation Research* **1**, 354 (1953).

18 November 1954.

## Alkaloid Formation in Ergot Sclerotia

Yen Hoong Loo

Lilly Research Laboratories, Indianapolis, Indiana

Ralph W. Lewis

Michigan State College, East Lansing

In exploring the possibilities of producing ergot alkaloids by culturing *Claviceps purpurea*, it is desirable to know at what time in the life-cycle of the fungus the alkaloids normally make their appearance. To determine this fact, a plot of tetraploid Rosen rye (1) was inoculated on 5 and 6 June 1954 by spraying the flowers each day with a sugar-spore suspension (2). The spores were produced in shake cultures on a medium of 40-percent commercial sucrose in a po-

tato broth prepared by boiling 400 g of sliced potatoes in sufficient water to produce 1 lit of broth when decanted (3). Spores produced in this manner are far superior in yield, percentage germination, and longevity in storage than spores produced in wheat cultures as previously described (2).

Samples were collected 8, 10, 12, 15, 17, 19, and 26 days after the inoculation of 6 June (Fig. 1 A-G). Each sample consisted of 200 or more heads cut at random from the plot. The heads were dried for 2 days at a temperature of 60° to 80° C. Many heads were dissected to secure all the sclerotia in each head. Figure 1 shows 10 representative sclerotia from each sample; the average weight of the sclerotia is given in the legend.

The "sclerotia" collected on the 8th day can hardly be called sclerotia. Most of them show only a little purple pigment, and this is usually at the base. A few have no purple pigment at all and these are often nothing more than the ovary of the rye flowers overgrown with mycelium. The surfaces of all "sclerotia" of this age, especially the upper surface of the older ones, are covered with conidia and conidiophores.

In most of the sclerotia collected on the 10th day (Fig. 1 B) the basal pigmented portion has enlarged so that it forms one-half or more of the whole structure. The upper, nearly nonpigmented portion is the asexual development, and it does not enlarge once the true sclerotium begins to grow. With rare exceptions, all sclerotia collected on the 12th day and after (samples C to G) are heavily pigmented.

The amount and nature of the alkaloids produced during the development of the fungus were determined. Dried, pulverized samples of A to G were extracted with ammoniacal alcohol. After removal of the alcohol, the alkaloids in the water layer were extracted at pH 8 into chloroform, then returned to aqueous maleic acid solution. The percentage of ergot alkaloids in these dried samples, determined colorimetrically by a modification of the Van Urk method (4) was as follows: A (0); B (0), C (0.005), D

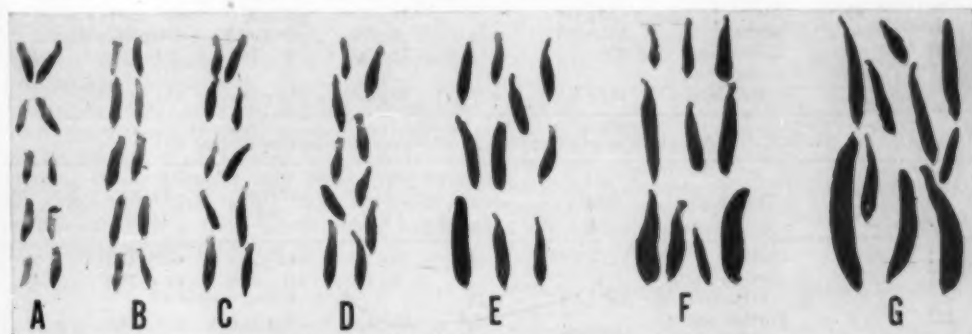


Fig. 1. Ergot sclerotia, natural size. The samples were collected on the following days after inoculation and have the average weights as noted: (A) 8th day, 4.9 mg per sclerotium; (B) 10th day, 6.2 mg; (C) 12th day, 7.3 mg; (D) 15th day, 10.2 mg; (E) 17th day, 23.2 mg; (F) 19th day, 38.0 mg; and (G) 26th day, 55.6 mg.

(0.013), *E* (0.05), *F* (0.14), and *G* (0.12). A visible absorption curve (400–800 mμ) of the blue reaction product that was formed from *C–G* was identical with that of authentic lysergic acid. Pharmacological assays by C. E. Powell (5) demonstrated an ergonovine type of activity in extracts of samples *C* to *G*. Paper-grams in a butanol-acetic-water system (6) identified ergonovine as the major component in the extracts exhibiting a blue fluorescence under ultraviolet light.

From these results it is apparent that the ergot alkaloids are largely synthesized in the fungus during the later stages of sclerotial development. No lysergic acid could be detected in samples *A* and *B* before pigment and sclerotium formation. Traces of the alkaloids appeared 12 days after inoculation. The amount gradually increased to a maximum on the 19th day when the fungus was still increasing in weight.

#### References and Notes

1. R. W. Lewis, *J. Am. Pharm. Assoc., Sci. Ed.* **37**, 511 (1948).
2. R. W. Lewis, *Phytopathology* **35**, 353 (1945).
3. R. W. Lewis, Eli Lilly and Co., unpublished.
4. N. L. Allport and T. T. Cocking, *Quart. J. Pharm.* **5**, 341 (1932).
5. E. E. Swanson, C. C. Hargreaves, and K. K. Chen, *J. Am. Pharm. Assoc.* **24**, 835 (1935).
6. H. L. Bird, Eli Lilly and Co., unpublished.

17 November 1954.

## Anticortisol Action of Aldosterone

Hans Selye

*Institut de Médecine et de Chirurgie expérimentales,  
Université de Montréal, Montréal, Canada*

Since the first description of the general-adaptation syndrome as the body's standard response to stress,

much attention has been given to the role played by adrenocortical hormones in the pathogenesis of various diseases. There is no longer any doubt that an increase in the secretion of ACTH and glucocorticoids (for example, cortisol) is an essential prerequisite for the maintenance of homeostasis during stress. It has also been shown that many activities of these hormones are inhibited by simultaneous treatment with somatotrophin or mineralocorticoids (for example, desoxycorticosterone). The medical importance of a proper balance between glucocorticoids and mineralocorticoids is most evident with regard to inflammation, because, in general, glucocorticoids suppress, while mineralocorticoids enhance, inflammatory responses to tissue injury. Consequently the former hormones have also been referred to as "antiphlogistic" and the latter as "prophlogistic" corticoids (1–3).

The greatest weakness of this theory was the lack of any direct proof that the adrenal gland actually secretes physiologically effective quantities of a mineralocorticoid comparable to desoxycorticosterone. This gap in our knowledge has now been filled by the discovery of "aldosterone," a highly active natural mineralocorticoid (4). Yet, the question still remained whether aldosterone is actually an antagonist of glucocorticoids.

Ninety-six female Sprague-Dawley rats, weighing 151 to 170 g (average 160 g), were bilaterally adrenalectomized and subdivided into four groups, as is indicated in Table 1. Throughout the observation period these rats were maintained exclusively on Purina Fox Chow and tap water, without special salt supplements.

Hormone treatment was initiated on the day of adrenalectomy. Cortisol was given in the form of Hydrocortone Acetate microcrystals (Merck) at the daily dose of 400 μg in 0.2 ml of aqueous suspension medium, subcutaneously in the chest region. Aldosterone

Table 1. Anticortisol action of 20 μg/day of aldosterone in adrenalectomized rats.

Group	No. of rats	Treatment	Final body weight (g)	Weight gain (g)	Exudate (ml)	Thymus (mg)	Spleen (mg)	Mortality (%)
I	40	None	178 ± 7.3	+ 18	14 ± 3	603 ± 41	906 ± 206	87
II	40	Cortisol	132 ± 3.6	– 28	3 ± 0.9	69 ± 8.3	490 ± 23	5
III	6	Aldosterone	172 ± 7	+ 12	12 ± 2.7	369 ± 46	934 ± 79	50
IV	10	Cortisol and aldosterone	155 ± 5.5	– 5	10 ± 1.2	105 ± 11	814 ± 113	0

Table 2. Anticortisol action of 50 μg/day of aldosterone in adrenalectomized rats.

Group	No. of rats	Treatment	Final body weight (g)	Weight gain (g)	Exudate (ml)	Thymus (mg)	Spleen (mg)	Mortality (%)
I	8	Cortisol	141 ± 5.6	– 19	8 ± 1.6	146 ± 13.9	665 ± 48.3	0
II	9	Cortisol and cholesterol	137 ± 3.6	– 23	9 ± 2.3	138 ± 22.8	690 ± 75.6	0
III	6	Cortisol and aldosterone	161 ± 3.3	+ 1	17 ± 1.0	191 ± 16.0	959 ± 98.3	0
IV	10	Cortisol and DCA	158 ± 2.1	– 2	13 ± 2.1	229 ± 18.0	978 ± 69.9	0

sterone (Ciba) (5) was injected into the inguinal region, at the dose of 20 µg/day in 0.2 ml of sesame oil.

For the quantitative assessment of inflammation, "granuloma-pouches" (6) were prepared 48 hr later by the injection of 25 ml of air under the dorsal skin; this was immediately followed by the injection of 0.5 ml of 1-percent croton oil (in corn oil) into the air space so created. All the animals were killed on the 14th day after adrenalectomy.

It is evident from Table 1 that, under these conditions, 20 µg of aldosterone slightly but significantly diminished the body-weight loss ( $P < 0.01$ ) and the inhibition of inflammatory-exudate formation ( $P < 0.01$ ) by cortisol. However, the involution of the thymus and spleen was not significantly suppressed.

A second experiment was therefore performed with a higher daily dose of aldosterone, but, in view of the scarcity of this hormone, the length of treatment had to be shortened. Thirty-six female Sprague-Dawley rats, weighing 154 to 183 g (average 160 g), were treated in essentially the same way as those of the first experiment, except that the granuloma-pouch was prepared on the first day, while treatment with steroids was begun 48 hr later, simultaneously with bilateral adrenalectomy. The dose of aldosterone was raised to 25 µg twice daily in 0.25 ml of sesame oil, and we added additional controls to which cholesterol (as an inactive steroid) and desoxycorticosterone acetate (Schering) (DCA, as a proved prothogistic corticoid) were administered at the same dose level. For uniformity's sake, cortisol was also given in two daily subcutaneous injections (each 200 µg in 0.25 ml of water). The animals were killed on the 12th day.

Table 2 indicates that, at the dose level of 50 µg/day, aldosterone inhibits a variety of characteristic cortisol actions. In this respect it is approximately equally active as DCA. Cholesterol—a hormonally inert compound—is devoid of such an inhibitory action.

Depending upon the test used, the mineralocorticoid activity of aldosterone has variously been estimated to be about 25 to 125 times that of desoxycorticosterone (7). On the other hand, with regard to their anticortisol effects, we find no striking quantitative difference between the activities of the two steroids. It is noteworthy, however, that despite this the natural mineralocorticoid, aldosterone, inhibits all the afore-mentioned morphologic actions of the natural glucocorticoid, cortisol in the proportion 1:8.

Thus, the concept according to which a balance between two opposing naturally secreted corticoids can regulate the course of various biologic phenomena, including inflammation, has now been proved by direct experimental observations, using corticoids the presence of which in the circulating blood had been demonstrated beyond doubt (8).

#### References and Notes

1. H. Selye, *Stress, the Physiology and Pathology of Exposure to Stress* (Acta, Montreal, 1950); *First Annual Report on Stress* (Acta, Montreal, 1951).
2. H. Selye and A. Horava, *Second Annual Report on Stress*

(Acta, Montreal, 1952); *Third Annual Report on Stress* (Acta, Montreal, 1953).

3. H. Selye and G. Heuser, *Fourth Annual Report on Stress* (Acta, Montreal, 1954).
4. S. A. Simpson et al., *Helv. Chim. Acta* **37**, 1163 (1954).
5. I am greatly indebted to A. Wettstein (Ciba Ltd., Basle, Switzerland) for a generous supply of aldosterone.
6. H. Selye, *J. Am. Med. Assoc.* **152**, 1207 (1953).
7. S. A. Simpson and J. F. Tait, in reference 3.
8. This work was supported in part by the Medical Research Board, Office of the Surgeon General, Department of the Army, contract No. 49-007-Md 186, and by a consolidated grant from the National Research Council of Canada.

4 January 1955.

## Gramine Derivatives Antagonistic to 5-Hydroxytryptamine (Enteramine)

V. Erspamer

*Institute of Pharmacology, University of Bari, Bari, and Farmitalia S.p.A. Research Laboratories, Milan, Italy*

It has been previously demonstrated that gramine (3-dimethylaminomethylindole) possesses, both *in vitro* and, to a lesser degree, *in vivo* a clear action antagonistic to 5-hydroxytryptamine (5-HT) (1, 2). In the present paper are briefly reported the main results obtained with nine gramine derivatives synthesized by Colò et al. (3) in the Farmitalia Research Laboratories.

The anti-5-HT activity of these derivatives was studied in respect to the spasmogenic effect of 5-HT on the rat estrous-uterus and to the antidiuretic effect of the substance in hydrated rats (4).

Table 1 shows the approximate dose of antimetabolite necessary to halve the uterus-stimulant effect produced by 0.1 µg of 5-HT base. For comparative purposes the values obtained with three of the most representative aminoindoles of Woolley and Shaw (5) are also included in the table: 2-methyl-3-ethyl-5-dimethylaminoindole (Medmain), 1,2-dimethyl-3-ethyl-

Table 1. Antagonistic effect of gramines and aminoindoles on the uterus-stimulant action of 5-HT.

Compound	50% antagonistic dose (µg) to 0.1 µg of 5-HT base
Gramine	3-6
2-Methylgramine	3-6
2-Methyl-5-aminogramine	200
2-Methyl-5-nitrogramine	3-5
2-Methyl-5-chlorogramine	0.3-0.4
2-Methyl-7-chlorogramine	0.5-0.8
2-Methyl-5-bromogramine	0.2-0.4
5,6-Dimethoxygramine	100
3-Diethylaminomethylindole	2-4
2-Methyl-3-piperidylmethyl-5-chloroindole	4-8
Medmain	6-8
Methylmedmain	3-5
2-Methyl-3-ethyl-5-aminoindole	50-60

Table 2. Action of gramines and Methylmedmain on 5-HT antidiuresis.

Compound	Amount (mg/kg)	No. of rats	Percentage water excretion						
			1 hr	1½ hr	2 hr	3 hr	4 hr	7 hr	
Controls (distd. water)		24	41	<i>63</i>	<i>71</i>	<i>79</i>	<i>85</i>	<i>106</i>	
5-HT	0.2	24	13	26	37	<i>52</i>	60	84	
5-Amino-2-methylgramine	10	12	35	<i>59</i>	62	73	82	102	
5-Amino-2-methylgramine + 5-HT	10 + 0.2	12	12	23	36	<i>52</i>	65	98	
5-Nitro-2-methylgramine	10	12	30	<i>51</i>	57	64	75	96	
5-Nitro-2-methylgramine + 5-HT	10 + 0.2	12	9	18	22	41	<i>56</i>	82	
5-Chloro-2-methylgramine	10	12	37	<i>53</i>	63	68	75	96	
5-Chloro-2-methylgramine + 5-HT	10 + 0.2	12	18	42	<i>53</i>	59	63	83	
Gramine	10	12	43	<i>59</i>	70	75	87	109	
Gramine + 5-HT	10 + 0.2	12	29	41	<i>56</i>	64	66	87	
Controls (distd. water)		12	39	<i>74</i>	77	86	98	118	
5-HT	0.4	12	5	21	33	<i>54</i>	65	86	
Methylmedmain*	20	12	48	<i>66</i>	82	84	88	111	
Methylmedmain†	20	12	25	<i>52</i>	62	71	77	102	
Methylmedmain* + 5-HT‡	20 + 0.4	12	10	29	40	<i>58</i>	61	86	
Methylmedmain* + 5-HT‡	20 + 0.4	12	2	10	22	44	<i>57</i>	88	
Methylmedmain† + 5-HT‡	20 + 0.4	12	2	17	38	<i>54</i>	72	99	
Methylmedmain† + 5-HT‡	20 + 0.4	12	6	9	21	46	<i>54</i>	88	

\* By subcutaneous route.

† By intraperitoneal route.

‡ Injection of Methylmedmain 30 min before 5-HT.

§ Simultaneous injection of Methylmedmain and 5-HT.

5-dimethylaminoindole (Methylmedmain), and 2-methyl-3-ethyl-5-aminoindole. At the concentration used no stimulation of the uterine horn resulting from the antagonists for 5-HT was observed.

The inhibition caused by gramine derivatives is always, at least in part, reversible, but the original reactivity of the preparation is restored only gradually. It may even happen that after a first washing with fresh nutrient liquid the antagonistic effect is more pronounced than in the presence of the anti-metabolite. The response of the rat uterus to acetylcholine is not significantly affected by the gramine compounds.

The antagonistic action on 5-HT antidiuresis of the drugs examined has always been rather weak and by no means proportional to their inhibiting action on the uterus-stimulant effect of 5-HT. None of the anti-metabolites was superior to gramine in this respect but, at best, equal to it (1). This is true even for 2-methyl-5-chlorogamine. The action of the gramine derivatives seems to be more intense by subcutaneous route than by intraperitoneal route. Methylmedmain, like Medmain and 2-methyl-3-ethyl-5-aminoindole (1, 4), displays a negligible influence on 5-HT antidiuresis up to 20 mg/kg doses, whatever the route and time of administration may be.

Some experimental results concerning the influence of gramines and aminoindoles on 5-HT antidiuresis are summarized in Table 2. All the gramines were given subcutaneously 30 min before the water load (5 ml tap water per kg of body weight, by stomach tube), which was followed by subcutaneous injection

of 5-HT; Methylmedmain was given by subcutaneous or by intraperitoneal route simultaneously with or 30 min before the water load and the injection of 5-HT. The attainment of approximately 50 percent water excretion is indicated by the figures in *italic* type.

Following intravenous injection of 1 to 10 mg/kg of 2-methyl-5-chlorogamine into a dog under pentobarbital anesthesia, both the pressor effect and the spasmogenic effect of 5-HT on the urinary bladder (6) are somewhat reduced but not abolished.

From these results we must conclude that while the anti-5-HT activity of some of the gramine derivatives studied appears to be very conspicuous when tested *in vitro* on the rat uterus preparation, the same activity is negligible when tested *in vivo* on the 5-HT antidiuresis test. It may be that this depends upon the rapid destruction of the drugs in the organism (7).

#### References and Notes

1. V. Erspamer, *Ricerca sci.* **23**, 1203 (1953).
2. J. H. Gaddum and A. Hameed Khan, *Brit. J. Pharmacol.* **9**, 240 (1954).
3. V. Colò, B. Asero, and A. Vercellone, *Il Farmaco, Ed. Sc.* **9**, 629 (1954).
4. V. Erspamer, *Rend. sci. Farmitalia* **1**, 1 (1954); *Pharmacol. Rev.*, in press.
5. D. W. Woolley and E. Shaw, *J. Biol. Chem.* **203**, 69 (1953); *Federation Proc.* **13**, 325 (1954); E. Shaw and D. W. Woolley, *J. Pharmacol. Exptl. Therap.* **111**, 43 (1954).
6. V. Erspamer, *Arch. Internal Med.* **90**, 595 (1952).
7. I am indebted to, and wish to thank, D. W. Woolley and E. Shaw of the Rockefeller Institute for Medical Research, New York, for generous samples of Medmain and Methylmedmain.

12 November 1954.



# Communications

## New Technique for Motivating and Reinforcing Children

To the extent that motivation and reinforcement have been systematically manipulated in research with children, typically poker chips or marbles have been used as secondary reinforcers, these to be collected by the child and cashed in for a piece of candy or small toy. This method, although successful, is cumbersome and sometimes delays experimental progress while the child manipulates the token reinforcer. Also, objections from nursery-school personnel may be incurred for the reasons that (i) candy is not good for children, or (ii) toys are disruptive when taken back to the play group. Although to the experimenter these objections may appear to be of little consequence, nursery-school personnel may consider them extremely important, and the opportunity to use children often depends on the consent of a nursery-school teacher or administrator. Partly as a consequence of these problems I have developed a technique that avoids the afore-mentioned difficulties and, through its flexibility, offers a number of interesting possibilities.

The essence of at least one type of reinforcement that is useful in the control of behavior is the contingency of the continuation of a pleasant or interesting state of affairs on the occurrence of a specific bit of behavior. Thus, any situation that will entertain a child and can also be readily turned off and on would serve this purpose. Both movies and music would appear to meet these latter criteria. Although movies might be expected to be more entertaining, I had a tape recorder, rather than a projector, at hand and have used music as a reinforcer with striking success.

Children's records were transferred to tape, and a delay interval timer was placed in the earphone circuit of the tape recorder in such a way that the music is cut off at preset intervals and can be turned on at the touch of a button. Normal children as young as 3 yr of age will stay in this situation for at least 30 min while pressing a button every 10 sec to continue the music. Greater flexibility is achieved by using a foot switch under the control of the experimenter to turn on the music. This arrangement permits the reinforcement of more complex responses. For example, mentally retarded children have been taught various concepts by reinforcing the response of pointing to a particular card or object of a pair placed on a table in front of the child. Also, a speech pathologist has given and withheld reinforcement for successive approximations to the desired speech sounds. In both of these situations the rapidity of learning has been marked, and both the experimenter and the speech pathologist have been very enthusiastic about the device.

Neither a tape recorder nor interval timer would appear to be essential, but it is my guess that the ear-

phones may enhance the effect and tend to limit extraneous behavior of the child. Otherwise, a simple on-off switch in the speaker circuit of any record changer would probably serve if the actual control of the music is to be left to the experimenter. Certainly a variety of other arrangements is also possible.

W. E. JEFFREY

Department of Psychology, Barnard College,  
Columbia University, New York

24 January 1955.

## Bonding in the Lanthanone Chelates

A criterion proposed by C. W. Davies (1) to distinguish between essentially ionic bonding and covalent bonding in electrolytes may be utilized to obtain information on the nature of the lanthanone chelates. The criterion proposed by Davies consists of two parts: (i) The behavior of alkalis and heavy alkaline earths is typically ionic. (ii) The logarithms of the ionization constants (in this case of the instability constants) will be directly proportional to the square of the ionic charge  $Z$  and inversely proportional to the ionic radius  $r$ . Although the application of the second part of this criterion to lanthanone complexes has been discussed (2-4) using data on two or three of the lighter lanthanones, a lack of experimental data has previously prevented its strict application to the lanthanones as a whole.

In Fig. 1 this criterion is applied to the data of

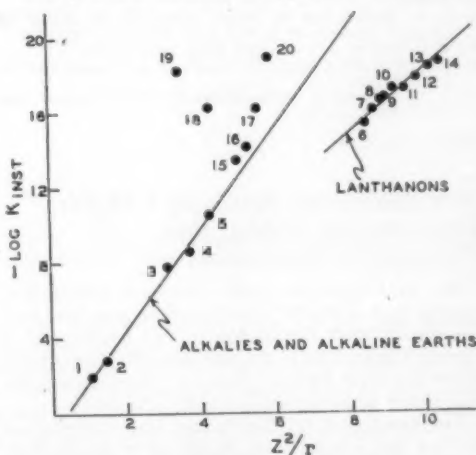


Fig. 1. Relationship between the logarithm of the instability constants and  $Z^2/r$  for metal chelates with ethylenediamine tetraacetic acid. (1) Na<sup>+</sup>, (2) Li<sup>+</sup>, (3) Ba<sup>2+</sup>, (4) Sr<sup>2+</sup>, (5) Ca<sup>2+</sup>, (6) La<sup>3+</sup>, (7) Ce<sup>3+</sup>, (8) Pr<sup>3+</sup>, (9) Nd<sup>3+</sup>, (10) Sm<sup>3+</sup>, (11) Gd<sup>3+</sup>, (12) Dy<sup>3+</sup>, (13) Er<sup>3+</sup>, (14) Yb<sup>3+</sup>, (15) Mn<sup>2+</sup>, (16) Fe<sup>2+</sup>, (17) Co<sup>2+</sup>, (18) Cd<sup>2+</sup>, (19) Pb<sup>2+</sup>, (20) Ni<sup>2+</sup>.

Vickery (5) and that collected by Martell and Calvin (4) on ethylenediamine tetraacetic acid chelates. The ionic radii of the lanthanons have all been obtained from the work of Templeton and Dauben (6) and those of the other elements from Ketelaar (7). Davies considers that covalent bonding occurs in those cases in which the stability of the bonds is greater than that expected for an alkali-like ion of identical  $Z^2/r$  value. It is apparent from the figure that the lanthanon chelates are ionic in nature, the stabilities actually being less than expected. Their behavior contrasts markedly with that of the transition elements included in the figure for comparison. A possible explanation for the behavior of the lanthanon chelates lies in the small size of the ions and their large charge. The required number of chelate groups are prevented from approaching one another as closely as expected in the resultant complex because of their mutual repulsions. An extension of the figure would show that the  $\text{Fe}^{\text{III}}$  and  $\text{Cr}^{\text{III}}$  complexes are less stable than expected for ionic bonding. This does not prevent considering these as ionic complexes in spite of the optical stability of any resolved complexes. Such stability is primarily dependent upon the magnitude of the instability constant rather than the type of bonding.

Department of Chemistry,  
University of Illinois, Urbana

#### References

1. C. W. Davies, *J. Chem. Soc.* **1951**, 1256 (1951).
2. D. Dryssen, *Svensk. Kem. Tidskr.* **66**, 234 (1954).
3. A. E. Martell and R. C. Plumb, *J. Phys. Chem.* **56**, 993 (1952).
4. A. E. Martell and M. Calvin, *Chemistry of the Metal Chelates* (Prentice-Hall, New York, 1952), pp. 537-538.
5. R. C. Vickery, *J. Chem. Soc.* **1952**, 1895 (1952).
6. D. H. Templeton and C. H. Dauben, *J. Am. Chem. Soc.* **76**, 523 (1954).
7. J. A. A. Ketelaar, *Chemical Constitution* (Elsevier, New York, 1953), pp. 28-29.

26 November 1954.

### New Hemoglobin Possessing a Higher Electrophoretic Mobility than Normal Adult Hemoglobin

We have observed a new abnormal hemoglobin, moving with a higher electrophoretic mobility than the normal adult hemoglobin, in two members of a Chinese family. This is the sixth abnormal hemoglobin discovered since Pauling *et al.* (1) characterized the first abnormal hemoglobin in sickle cell anemia.

Five members of this family have been studied since we first saw one of them in our office on 23 Mar. 1954; they are represented by solid enclosures on Fig. 1. They were seen because of a severe hypochromic, microcytic anemia that was indistinguishable on stained smears from hereditary leptocytosis, first noted in patient 9. A similar picture was detected in the blood of patient 10; and both patient 9 and patient 10 give a lifelong history of easy fatigability and

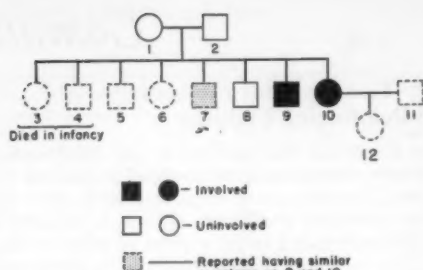


Fig. 1. Genetic table of family showing occurrence of new abnormal hemoglobin.

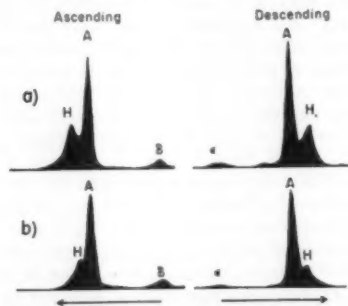


Fig. 2. Electrophoretic patterns of hemoglobin: (a) from subject 10; (b) from subject 10 mixed with normal.

both have splenomegaly. Blood from subjects 1, 2, and 8 showed no abnormality.

Electrophoretic analyses of hemoglobin from subjects 9 and 10 performed at that time in Veronal buffer pH 8.6, ionic strength 0.1, revealed two distinct hemoglobins, as is shown in Fig. 2a. The slower one has the same electrophoretic mobility as the normal adult hemoglobin, as can be seen in Fig. 2b, where hemoglobins from a normal individual and patient 10 were mixed. The faster hemoglobin, accounting for 35 percent of the total, is abnormal and is hitherto undescribed. Electrophoretic patterns of subjects 1, 2, and 8 showed only adult hemoglobin.

Since hemoglobin G is the most recently described (2), it is proposed that the abnormal hemoglobin described here be designated as hemoglobin H. The genetic pattern does not seem to follow that of other abnormal hemoglobins, since neither parent possesses the abnormal hemoglobin.

DEMETRIOS A. RIGAS  
ROBERT D. KOLER  
EDWIN E. OSGOOD

Division of Experimental Medicine,  
University of Oregon Medical School, Portland

#### References

1. L. Pauling *et al.*, *Science* **110**, 543 (1949).
2. G. M. Edington and H. Lehman, *Lancet* **267**, 173 (1954).

17 January 1955.

## Use of Auditory Stimuli to Maintain Lever-Pressing Behavior

This note presents a method of maintaining lever-pressing behavior in the rat by the use of a noxious auditory stimulus (1).

In experiments in which behavior is maintained by the escape or avoidance of a noxious stimulus, electric shock is usually employed as the stimulus (2). Electric shock, however, has a number of disadvantages. The current density the animal receives at each presentation of the shock is far from constant, the adjustment of the value of the current is often critical if consistent results are to be obtained, and the grid has to be designed with considerable care (3). Also, the animal is likely to become difficult to handle when its behavior is shock-maintained. Some of these difficulties may be overcome by the use of light as the noxious stimulus. A disadvantage of this method is that the animal can escape the light by a variety of behavior other than lever pressing. For example, the animal may close its eyes or crouch in a corner away from the light.

The noxious auditory stimulus consisted of a random signal reproduced over a University "tweeter" speaker having a frequency response range up to approximately 15,000 cy/sec. The noise had been previously recorded on an Ampex tape recorder, Model 600, which also has a frequency response up to 15,000 cy/sec. The "tweeter" was connected to the output of the amplifier by a 1- $\mu$ f condenser. This attenuated frequencies of 1000 cy/sec about 10 times and frequencies of 10,000 cy/sec 2 times. This combination of components insured that the noise reaching the animal consisted principally of high audio frequencies. The noise was continually present unless the animal pressed the lever. Each lever press terminated the noise for a period of 16 sec. If the animal responded during the silent period, a further 16 sec was added to the period, commencing from the time of the second press.

An animal was run until it reached a steady rate of response. A cumulative response curve was recorded for this animal after the manner suggested by Skinner (4). This curve, after 30 hr of escape behavior, is shown in Fig. 1. Once an animal has reached a steady response rate, the functional relationship between the response rate and the intensity of the sound can be readily obtained by running the animal at decreasing

intensities. The response rate is correlated with the intensity of the stimulus. This is demonstrated in Fig. 2 by the change in the slope of the curve at the points where the intensity of the sound has changed. The greatest intensity at which extinction occurs is a use-

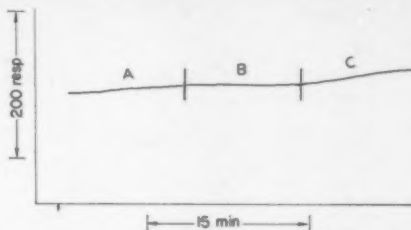


Fig. 2. Cumulative response curve of escape behavior at three different intensities of sound. The silent period was 16 sec throughout. Intensity  $C >$  intensity  $A >$  intensity  $B$ .

ful measure of the auditory threshold. At any given intensity of the stimulus, the rate of lever pressing is largely determined by the duration of the silent period following each response. Thus, different rates for any given intensity can be selected by choosing an appropriate silent period. The effect of varying this period while leaving the intensity constant is shown in Fig. 3. The effect of the alteration of the silent period is immediately apparent in the cumulative response curve. When one returns to the initial period, the initial rate is obtained.

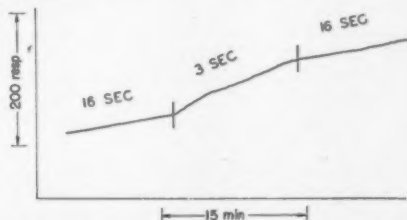


Fig. 3. Cumulative response curve of escape behavior at three different silent periods. Intensity the same as  $C$  of Fig. 2.

The behavior of seven more rats has been investigated in this apparatus. The results are essentially the same as those reported for the first. It has also been found that it is possible to alternate the aversive sound with a positive food reinforcement in a dual schedule. With such a program the animal's response rate shifts in accordance with the schedule. Intersession response variability to the aversive sound appears to be roughly commensurate with that found for positive reinforcement schedules. In spite of this variability, day by day intensity-rate functions are clearly discriminable with little or no overlapping, once the appropriate intensities have been empirically ascertained.

This method of maintaining lever pressing is at present being used in conjunction with the investiga-



Fig. 1. Cumulative response curve of escape lever-pressing behavior after 30 hr of training.

tion of the behavior changes produced by bilateral lesions of the hippocampal system. It should be useful, also, when combined with food-maintained behavior in investigations of any variables that are considered to be related to the affectivity of the animals (5).

J. M. HARRISON

W. H. TRACY

Psychological Laboratory, Boston University,  
Boston, Massachusetts

#### References and Notes

1. This experiment is part of a research program carried out under contract G 919 between Boston University and the National Science Foundation, principal investigator, J. M. Harrison.
2. M. Sidman, *Science* **118**, 157 (1953).
3. B. F. Skinner and S. L. Campbell, *J. Comp and Physiol. Psychol.* **40**, 305 (1947).
4. B. F. Skinner, *The Behavior of Organisms, An Experimental Analysis* (Appleton-Century, New York, 1938).
5. C. B. Ferster, *Science* **120**, 269 (1954).

13 December 1954.

### Inexpensive Stain for Paper Electrophoresis

Bromphenol blue is an expensive dye, as one soon learns when doing large numbers of paper-strip electrophoresis determinations. Since light green SF can be used satisfactorily at less than 10 percent of the cost of bromphenol blue and, in addition, does not require washing with alcohol or preparation with mercuric chloride, its use may be attractive to others. In our hands the strips have proved to be the equal in all respects of those stained with bromphenol blue (1). Griffith (2) suggested that there were several stains of possible value in staining these strips; our best results were with the light green, although fast green may be used interchangeably (it is slightly more expensive).

A modification of the Grassmann technique (3) for paper-strip electrophoresis was followed using Whatman No. 3 filter paper strips  $\frac{3}{4}$  in. in width. Serum was streaked across the base line using a hemoglobin pipette (20 mm<sup>3</sup>). Barbiturate buffer, pH 8.6, was employed, and the strips were run overnight (approximately 15 hr) at 3.5 ma. After oven-drying for  $\frac{1}{2}$  hr at approximately 105°C, the strips were ready for staining.

A shallow glass dish large enough to allow the

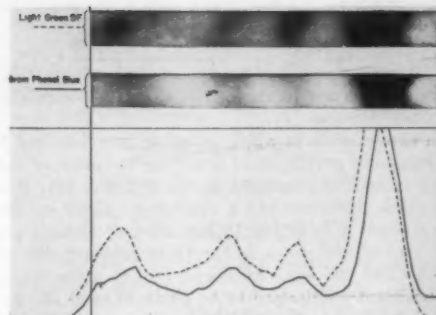


Fig. 1. Paper electrophoresis strips run simultaneously and stained by standard bromphenol blue technique (solid line) and light green SF (dashed line). Curves drawn from Photovolt Densitometer Model 425.

strips to lie flat (Pyrex baking dish) was used. Strips were first immersed 5 to 8 min in 1-percent acetic acid solution. The acetic acid enhances the adsorption of the proteins on the filter paper and minimizes their loss on developing (4). This original wash was saved. The strips were then immersed for 5 to 8 min in 1-percent light green SF dissolved in a 1-percent solution of acetic acid in distilled water. They were then washed with the original 1-percent acetic acid using gentle agitation for about 1 min. This was repeated three times, using fresh 1-percent acetic acid, a total of four washes. The final wash was allowed to remain on the strips 5 to 8 min with occasional agitation. Further handling of the strips depends on individual needs. Our strips were air-dried, cleared with mineral oil, mounted in 1-in. Scotch tape, and scanned with a Photovolt Densitometer Model 425.

LENORE A. RIDEOUT  
ROBERT W. PRICHARD

Department of Pathology,  
Bowman Gray School of Medicine,  
Winston-Salem, North Carolina

#### References and Notes

1. This work was supported in part by a research grant E-631(c) from the National Microbiological Institute, National Institutes of Health, U.S. Public Health Service.
2. L. L. Griffith, *J. Lab. Clin. Med.* **41**, 188 (1953).
3. W. Grassmann and K. Hannig, *Naturwissenschaften* **37**, 496 (1950).
4. H. J. McDonald et al., *Clin. Chemist* **5**, 51 (1953).

28 January 1955.

*Our delight in any particular study, art or science rises in proportion to the application which we bestow upon it. Thus, what was at first an exercise becomes at length an entertainment.*—JOSEPH ADDISON.



sly  
lid  
wn

ips  
cid  
of  
eir  
ed.  
er-  
ion  
nen  
ing  
ted  
otal  
ain  
ion.  
ual  
eral  
h a

OUT  
ARD

rrant  
Na-  
ce.  
(950).



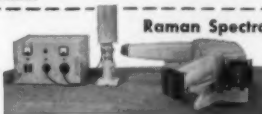
**HANDICAPPED**  
by faulty lab  
instrumentation?

turn to **JAcO**  
for  
instruments that will  
make your job easier



**JAcO Console  
Comparator  
Microphotometer**

New desk height console style with controls arranged for left hand use to free writing hand. Manual coarse motion control and motor driven fine motion with speed approximately 5 microns per sec. Bright image — may be viewed in normally lighted room. Scanning period and distance controlled by foot switch or push button.



**Raman Spectrograph**

Source features four low pressure mercury lamps inside diffuse reflector — four times more efficient than reflecting mirrors. Increased brightness reduces exposure time from hours to minutes. Specimen cells are easy to change. Spectrograph has two high speed cameras (F/1.5 and F/5.7) mounted on pivot for rapid interchangeability. Ideal research and industrial instrument.



**Hilger  
Micro-Focus  
X-Ray Unit**

Wide application in both diffraction and micro-radiography. Features low exposure time, high resolution, and provision for utilization of special techniques. Focal spot diameter is of the order of 0.04mm. Wide range of interchangeable targets. Safety interlock switches eliminate possibility of misuse.

Other JAcO Instruments: Source  
Units, Microphotometers, Refractometers,  
Photoprocessors, Polarimeters,  
Interferometers, Direct Reading  
Spectrometers, Blood Arithmometer,  
Geophysical Instruments



SALES OFFICES

represented exclusively in U.S.A. by  
**JARRELL-ASH COMPANY**

26 Farwell St., Newtonville, Mass.

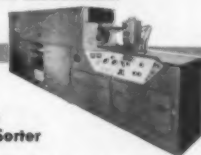
DETROIT  
13680 Capital Ave.

EL CERRITO, CAL.  
1344 Devonshire Drive

PITTSBURGH, PA.  
916 Greenhill Road

Why let outmoded instruments — or even lack of proper instruments — stymie your research or production control procedures? Discover how JAcO designed-for-the-job equipment can help you do your job more efficiently and at less cost.

Write for specific catalogs or describe your procedures and we'll send information on all applicable JAcO Instruments.



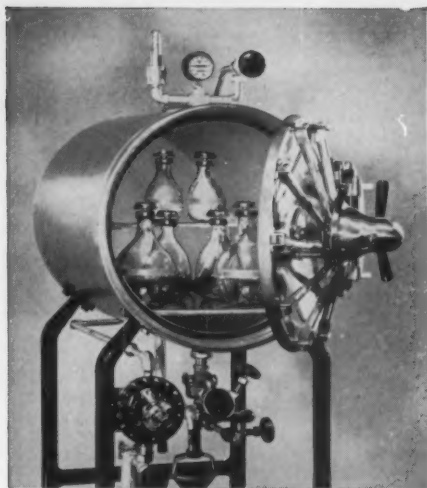
**JAcO Ebert  
Spectrograph  
with Order Sorter**

The widely acclaimed JAcO Ebert Spectrograph is now available with a new Order Sorter that presents several orders simultaneously at high dispersion, each as an individual spectrum. Dispersion up to 0.18 Å/mm, resolution 300,000. Low scattered light, flexible in application, easy to interpret determinations.

**Hilger  
Littrow  
Spectrograph**



Twist-of-knob wavelength region selection and automatic focusing on any region selected are outstanding advantages. Stigmatic image eliminates shifting of accessories. High speed optics are durable, sturdily mounted. Automatic shift from quartz to glass optics. Features high dispersion and resolution in critical U.V. areas.



### **uniform heat...to make your work more accurate**

When your work depends on keeping *uniform* temperatures, you'll like the way Castle Autoclaves keep heat the same in *all parts of the chamber!*

Air and condensation are automatically discharged by a thermal device. Special steam circulatory system and full air evacuation regulate temperature, assure you of accurate results.

Condensation hood prevents moisture dripping on contents. Temperature is selective from 105°C. to 130°C. Pressure regulated automatically; can be set from 5 to 15 p.s.i.

All autoclaves built of Monel metal, with extra heavy fittings for longer wear, harder use.

Single and double models available. Sizes from 16" diam. x 24" length, up to 21" diam. x 38" length.

For details and prices (or for Rectangular Autoclaves) phone your Castle dealer, or write for Bulletin Q-8.

**Castle** BACTERIOLOGICAL  
APPARATUS  
WILMOT CASTLE CO.  
1212 UNIVERSITY AVE., ROCHESTER, N. Y.

## **LaMOTTE**

### **COMBINATION SWIMMING POOL SET**

for small pools and those who do not care to install separate units for chlorine and alkalinity.

This unit is applicable to the ranges of chlorine and alkalinity actually required for swimming pool water, and will enable the operator to keep his alkalinity and chlorine values between the limits required by State Health Department specifications.



They are complete with 3 color standards for each test representing the upper and lower limits of chlorine (0.2, 0.5, 0.7) and alkalinity (pH 7.2, 7.6, & 8.0) together with reagents and necessary glassware.

These units are contained in a plastic comparator block, the top of which serves for making tests. The plastic blocks are moisture resistant and ideal for use around pools.

**LaMotte Chemical Products Company**  
Dept. "H" Towson, Baltimore 4, Md.



## **MICROBIOLOGICAL ASSAY**

Difco Media are available for the microbiological assay of antibiotics, vitamins and amino acids. Media for antibiotic assay are prepared according to specifications of the Food and Drug Administration.

Media for the microbiological assay of vitamins and amino acids are free from the essential growth requirement factor for which the medium is recommended. The addition of this factor in specified increasing concentrations elicits a growth response of the test organism which may be measured acidimetrically or turbidimetrically. Appropriate media for carrying cultures in stock, and preparation of inocula for each test are available.

Complete details of media for Microbiological Assay available upon request.

**DIFCO LABORATORIES**  
DETROIT 1, MICHIGAN





# Now! Get more bench space when and where you need it!



- Rolls along the bench on guide rail
- Locks in any position, easily moved
- Always level at any bench height
- Fitted by anybody . . . in a jiffy!

*Write today for literature and prices.*

## gives 5 sq. ft. extra working space right at the bench!

ROLLA-BENCH gives you extra room to make notes, for specimens, for extra apparatus . . . provides 18" x 24" (24" x 30" with the flap up) additional bench space, rigidly connected and level with the permanent bench or table. Can instantaneously be rolled along to a new position.

ROLLA-BENCH slots into an Aluminum Alloy guide rail along the permanent bench and is supported at the front by tubular steel legs with large solid rubber castors. Drawers or cupboards are not interfered with. Solid teak top. Complete with 9 ft. of rail and screws ready for installation. Leg height adjustable from 28" to 38" high.

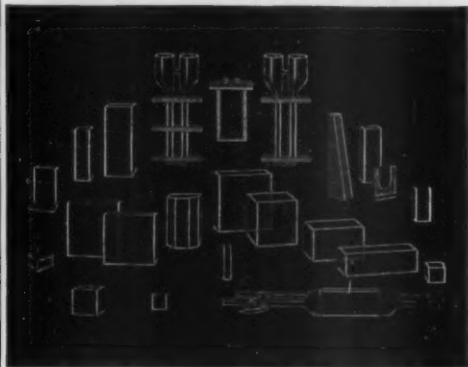
© Patent Pending

## PALO LABORATORY SUPPLIES, Inc.

81 Reade Street • New York 7

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D. C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of March 3, 1879. Annual subscriptions: \$7.50; foreign postage, outside the Pan-American Union, \$1; Canadian postage, 50¢.

## GLASS ABSORPTION CELLS made by **KLETT**



Makers of Complete Electrophoresis Apparatus

### SCIENTIFIC APPARATUS

Klett-Summerson Photoelectric Colorimeters—  
Colorimeters—Nephelometers—Fluorimeters—  
Bio-Colorimeters—Comparators—Glass Stand-  
ards—Klett Reagents.

**Klett Manufacturing Co.**  
179 East 87 Street, New York, New York

## WINTHROP'S 1955 PRICE LIST

on Bulk Chemicals

**IS NOW READY!**

If you want a copy,  
fill out coupon below.



Winthrop-Stearns Inc.  
Special Chemicals Division  
1450 Broadway, N. Y. 18

NAME .....

FIRM .....

STREET ADDRESS .....

CITY ..... ZONE ..... STATE .....

SW-35

4A

**PRECISION**  
**makes**

the complete line  
in Research  
Laboratory  
Equipment

Precision Scientific Company manufactures a COMPLETE SELECTION of more than 1500 items for use in research laboratories. Quality control and high manufacturing standards at our factory assure you of top performance on any item stamped with the "Precision" name. Always specify Precision when you order items like these:

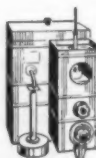
### Freas Ovens

Gravity or mechanical convection, floor, table or wall mounting types. Hazard-safe, explosion-proof and vacuum models. Also incubators, sterilizers, conditioning and annealing ovens and humidity cabinets.



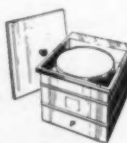
### Petroleum Testing Apparatus

All types of equipment for the petroleum laboratory. Unique Front-View Distillation Units shown promote accuracy and easier use by centralizing all controls and reading instruments in front. More compact, space-saving design.



### Metallurgical Hand Polisher

Ideal for small laboratories or for standardized hand polishing procedures in larger labs. Enclosed drive mechanism and lifetime sealed motor assure long, dependable operation. Exceptionally quiet.



### "Time-It" Electrical Stop Watch

Large, legible indicating counter easier to read than conventional watches. Readings to 1/10 second! Can be re-set to zero from any reading or successive readings can be totaled.



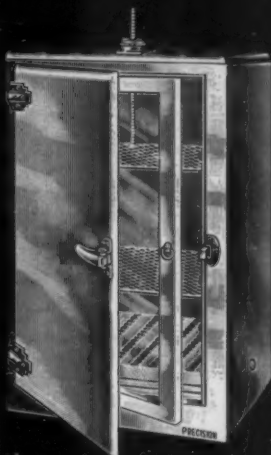
Write for free Bulletins on any of the above equipment.

**Precision Scientific Company**

3739 West Cortland Street  
Chicago 47



**MODEL 2**  
Working Chamber  
13"W x 14"D x 13"H  
Price \$115.00



**MODEL 4**  
Working Chamber  
18"W x 18"D x 27"H  
Price \$160.00



**MODEL 6**  
Working Chamber  
35"W x 18"D x 27"H  
Price \$295.00

## How **PRECISION** *Thelco* **INCUBATORS** help you buy more laboratory equipment

■ Measure your incubator requirements—won't the Thelco features listed below more than answer your needs? If so, why buy a more expensive cabinet? Buy Thelco—and use the money you save to buy other equipment.

Thelco Incubators save you money in other ways, too. They're so durable that your maintenance and repair costs are held to a minimum—so reliable that your time and materials are never wasted. So, be practical, specify Thelco and spend the difference.

**WIDE TEMPERATURE RANGE** 5° above room temperature to 60°C makes Incubator also suitable for paraffin embedding.

**AUTOMATIC TEMPERATURE CONTROL**—Accurately maintains constant temperatures over entire operating range. Bi-metallic thermoregulator inside cabinet for instant response to temperature changes.

**ALL-WELDED STEEL**—No screws to loosen with expansion and contraction cycling. Smooth, double-walled attractive appearance.

**DUST-TIGHT, DRAFT-TIGHT INNER DOOR**—Opens full width of working chamber, permits observation without disturbing inside temperature conditions. Inner door catch.

**SAFETY LATCHED OUTER DOOR**—Protects against dangerous internal pressures. Snap locks for positive closure.

**BRAIDED ASBESTOS GASKET**—Long lasting for permanent heat seal.

**BLACK HEAT OPERATION** — Heater never is incandescent. Black heat is safe in the presence of volatiles, gives longer heater life.

**THICK GLASS WOOL INSULATION** on all sides including door. Won't pack, crush or absorb moisture.

**MAXIMUM CAPACITY**—new design makes best use of laboratory space, offers more inside incubation space. For example, Model 6 has inside volume of 10 cu. ft., more than most home refrigerators.

Available for immediate shipment. Described in Catalog No. 331

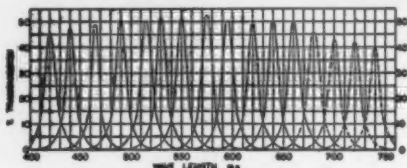
**Precision Scientific Company**

3739 WEST CORTLAND STREET • CHICAGO 47

## G.A.B. Interference Filters

(Made in Switzerland)

for isolating narrow spectral bands



Spectral Range: 400-900 millimicrons

Spectral Width: 12-15 mμ, Transm.: 45-50%

Size: 2" x 2". Other sizes on order.

For

Flame Photometry and Color Densitometry

Microscopy and Photomicrography

Colorimetry and Fluorimetry

also in reflectometry, light scattering measurements, microcolorimetry, refractometry, polarimetry, and in all other fields requiring monochromatic light in the visible and near-infrared range.

Write for Bulletin #180 to

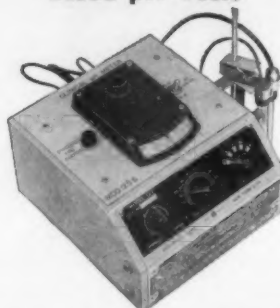
**PHOTOVOLT CORP.**

95 Madison Ave.

New York 16, N. Y.

## PHOTOVOLT

Clinical pH Meter Mod. 125-B for  
Blood pH Tests



High accuracy, combined with simplicity of operation and maintenance. **\$165.—**

Write for Bulletins Nos. 118 and 122 to:

**PHOTOVOLT CORP.**

95 Madison Ave.

New York 16, N. Y.

Also: Densitometers for Paper Electrophoresis • Clinical Colorimeters • Fluorimeters • Hemoglobinometers • Exposure Photometers for Photomicrography • Fluorescence Comparators for Diagnex Test • Interference Filters

## Now available...

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acid; Carotene, cryst.; Catalase; Cellulase Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetoneamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyrindyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Hordenine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropyl-arterenol; Kojic Acid; Kynurenine Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melaxitose; Mesobilirubinogen; Muscle Adenylic Acid; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothentic Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridzin; Phosphorylase; Piperin; Porphyrindine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salmine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

**DELTA CHEMICAL WORKS, INC.**

23 West 60th St. New York 23, N. Y.

Telephone Plaza 7-6317

## THE RICKETTSIAL DISEASES OF MAN

• This symposium volume is a comprehensive survey of the general field of Rickettsial diseases in man. Among the contributors appear the names of many of the foremost American authorities in this important and relatively new field of medicine.

• The first group of papers includes discussions of the taxonomy, biology, isolation, and identification of vectors, and reservoirs of infection of the Rickettsial diseases of man. The second group of papers is devoted to discussions of serological reactions, the Weil-Felix reaction, the complement-fixation and agglutination reactions, and the preparation and standardization of Rickettsial vaccines. The final group of papers treats of insecticides, methods of their application, and mite control.

To: **AAAS Publications**

1515 Mass. Ave., N.W., Washington 5, D. C.

Please accept my order for one copy of *The Rickettsial Diseases of Man* (7½ x 10½, cloth-bound). My check in correct payment is enclosed (\$5.25 to A.A.A.S. members, \$6.25 to those who are not members; including postage.)

Name .....

Address .....

City ..... Zone .... State .....





#### AAAS EDITORIAL BOARD

Dael Wolfe

*Acting Editor*

Charlotte V. Meeting

*Assistant Editor*

Mark H. Adams      Bentley Glass  
William R. Amberson      Karl Lark-Horovitz  
Wallace R. Brode      Edwin M. Lerner  
William L. Straus, Jr.

*Advertising Representative: F. A. Moulton*

### Science and the Public

ALL science writers must start on the following basis: decide on the readership one is trying to reach, assess the extent of the basic scientific knowledge possessed by that readership, and then build upon that knowledge in the full understanding that it may be necessary to introduce some highly unfamiliar concepts and terms into the story. It is not necessary to think in terms of readers who have no interest in science: scientific matters have a lively interest to everyone with a normal sense of curiosity and wonder, although it is true that this sense can wither if the individual suffers a faulty education. Many people are inclined to underestimate the extent to which ordinary people who have never been inside a laboratory in their lives are interested in scientific facts and scientific ideas. The interest in astronomy, for example, is enormous and apparently insatiable, judging from the success which so many books about the stars achieve. On the other hand the science writer goes wrong, at least in my opinion, if he approaches the subject with the idea that every bright young person who reads his articles is a potential professional scientist. Such an approach is wrong because a community composed of nothing but scientifically-trained individuals would be an intolerable abomination; it assumes that science is synonymous with omniscience, which is a false idea as all sensible scientists readily admit.

It is always pleasantly surprising to find how acute is the general interest in scientific matters. Indeed nowadays one frequently comes across this paradox: people who do not come into professional contact with scientists have a livelier interest in the general trend of scientific progress than many a narrow-minded scientist who earns his livelihood by the practice of science. An anecdote which illustrates this to perfection was told by Lord Moulton, the brilliantly versa-

tile patent law expert who was appointed by the British Government chairman of the Dyestuffs Corporation of 1919, the organization which restored the fortunes of the British dye industry. Moulton met a solitary German on the top of a mountain.

I found he was a chemist, and I began to talk upon a chemical subject. He told me he was only an organic chemist. He had not exhausted my resources, and I began to talk of coal-tar and pharmaceutical products. Then he told me he was a coal-tar by-product chemist. That did not beat me, because I had just been fighting a case of canary yellow. I thought I would get some subject that was common to us, and I slipped into the subject of canary yellow. Still the same ominous silence for a time, and then he said "I am only coal-tar chemist dealing with blues." But I had not finished. With an Englishman's pertinacity, not believing I was beaten, I racked my brains for a coal-tar blue—I had had to advise on some case—and I gradually, without a too obvious change of subject, slipped into that. Then he finally defeated me, because he said in equally solemn tones, but equally proud of the fact, "I only deal with methyl blues."

Science ceases to be science, of course, once it is professionally compartmentalized to such an extent: a man who studies nothing but methyl blues is not a scientist but a machine, and it is to be hoped that such work will soon be taken over by machines. A more comforting thought, however, is the harmony between the interests of the layman and those of the broad-minded scientist. The ordinary person can be aroused to interest in most of the scientific items which can be made interesting to a 16-year-old schoolboy. It is this basic and universal interest on which the public relations of science must be constructed.

*Reprinted with permission from "Science and the press," by William E. Dick. [Impact of Science on Society 5, 167-168 (Sept. 1954)].*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D. C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

**Change of address:** The notification should reach us four weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including postal zone numbers, if any.

**Annual subscriptions:** \$7.50; foreign postage, outside the Pan-American Union, \$1.00; Canadian postage, 50¢. Single copies 25¢. Special rates to members of the AAAS. Cable address: *Advances*, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

*for*

## TEST ANIMAL DEPLETION EXPERIMENTS

**AVOID** the tedious, time-consuming work of preparing test diets in your own lab. Get dependable and uniform results by feeding GBI ready-to-use, biological research preparations. Our large scale production facilities enable us to offer economical and complete test diets for depleting test animals of various nutritional factors. Carefully prepared salt mixtures and dietary supplements are also available at reasonable cost.

- ▶ **GBI TEST DIETS**—Complete and ready-to-use for a wide range of nutritional investigations. Many standard diets offered and others custom-built to your specifications.
- ▶ **GBI SALT MIXTURES**—All official formulas available. Uniform composition and prepared under laboratory controlled conditions.
- ▶ **GBI PROTEINS**—Vitamin-Free or Regular forms of animal or vegetable proteins. Also in hydrolyzed powder or liquid.
- ▶ **GBI SUPPLEMENTS**—Crystalline or concentrated vitamins, amino acids, carbohydrates, enzymes, hormones, lipids and various research biochemicals.

---

Write for the 1955 GBI Catalog and "GBI Biological Test Diets" bulletin for complete listings and prices.

---



### General Biochemicals, Inc.

60 LABORATORY PARK • CHAGRIN FALLS, OHIO







## Kodak reports to laboratories on:

an idea for making extra copies of oscillograms... the parent member of the isatoic anhydride series... identifying very meagre samples

### Plug

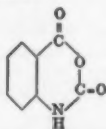
Reproduction is more to us than merely one of the basic biological functions; to us the word signifies the major market for our silver-sensitized paper. We read it literally to mean the copying of all manner of records and provide a large array of means, ranging from a little marvel of the age called the *Verifax Copier* (3 copies in 1 minute for less than 4¢ each) to simple sheets of *Kodagraph Contact Paper*.

A free plug for the latter, doubly welcome because we hadn't planted it, gladdened our eyes in a recent issue of *Electronics*. Little did it matter to us that the kind writer in his enthusiasm asserted a virtue for *Kodagraph Contact Paper* which even we have never claimed—that it requires only subdued room light instead of a proper darkroom for handling without danger of fogging. Just pleased that the fellow has a smart little scheme for using the paper in making inexpensive high-quality copies of cathode-ray tube oscillograms to include in manuals and laboratory reports.

For the details of his scheme, or for general guidance on the host of materials and methods for the photographic reproduction of intelligence, write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

### Extramural apathy

There was an inquiry from a customer as to whether we could supply isatoic anhydride:

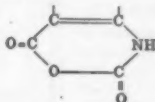


Too frequently, perhaps, such an inquiry piques our curiosity enough to try out an idea or two. First thing we know, there is the compound, purified and in a bottle on the shelf. So we write back and tell the inquirer that we have it now, then find he doesn't really want it—just wondering if we could supply it, which is his privilege. That is how *Isatoic Anhydride* came into our list as

Eastman 6975.

There, presently, one of our own chemists from another part of the enterprise noticed it and put in a requisition for a few grams. Shortly afterwards another of our laboratories wanted some. Then another internal requisition, and another. Apathetic though the rest of the world might be about *Isatoic Anhydride*, it was apparently doing us good inside.

Surely we are not alone in our interest in this echo of Baeyer's work of eighty years ago on indigo chemistry. *Isatoic Anhydride*, a creamy powder melting at 240 C with decomposition. The name, easily misread, is from *isatis*, Greek for woad. A little birdie called *Org. Reac.* has told us that the



grouping, which is characteristic of isatoic anhydrides as a class, reacts with hydrazine to make an excellent source of hydrazides of certain amino acids. Of course, what we are discussing here is only the parent member of the isatoic anhydride series and that doesn't make a particularly interesting amino acid hydrazide.

We stock some 3500 organic compounds in addition to *Isatoic Anhydride*. They're all in our List No. 39, available without charge from Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

### Infrared beam squeezer



The lens you see here is not glass but silver chloride, which is transparent all the way out beyond 17μ in the infrared. The speck it magnifies is typical of specks for which

we run infrared absorption spectra in the course of solving our daily little problems. We use such lenses not as magnifiers but to constrict one of the beams in a double-beam infrared spectrophotometer so that all its flux can be put through a 0.75mm x 3.5mm aperture. This permits the use of a very small sample. Then a second such AgCl lens collimates the beam again.

The samples, frequently weighing 50 micrograms or less, are handled by grinding the material to be examined with a little potassium bromide and compressing to a narrow strip. Nothing is dissolved in the process, and there is less chance for reactions and extra absorption that might mask the few micrograms of organic material we seek to identify. KBr puts no dips of its own into the chart.

This procedure is much less expensive than working out reflecting microscope optics and hitching them to a spectrophotometer. We got into it in identifying spots on film that our testing department won't let us sell. It might interest others who have only very meagre samples to work with, like those who study blood and other life juices.

Since most infrared spectroscopists aren't as lucky as we in having a great optical factory in the immediate family, we thought it would be a friendly deed if we made up a stock of silver chloride lenses for anybody who wants to try out this wrinkle of ours.

The price is \$102 for a set of Kodak Infrared Microsample Optics, consisting of an unmounted pair of plano-convex AgCl lenses of 24mm diameter and 22mm focal length, coated with a black Ag<sub>2</sub>S smoke that cuts out radiation below 1μ, plus a similar plane-parallel plate for the reference beam. The deal is with Eastman Kodak Company, Special Products Sales Division, Rochester 4, N. Y. We'll throw in a set of mounting drawings or give you the name of an infrared equipment manufacturer who supplies the whole assembly ready to slip into his spectrophotometer. We can also supply reprints of our papers on the method.

Price quoted is subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are... serving laboratories everywhere

Kodak

# Outstanding

## McGRAW-HILL BOOKS

### GEOLOGY: Principles and Processes New Fourth Edition

By WILLIAM H. EMMONS; GEORGE A. THIEL, University of Minnesota; CLINTON R. STAUFFER, California Institute of Technology; and IRA S. ALLISON, Oregon State College. In press

Greatly improved and fully modernized, this excellent physical geology text will be far more richly illustrated than before and carefully designed to have the most effective visual and pedagogical appeal. As in previous editions, the book surveys broadly the general field of physical geology. It treats the place of the earth in the universe, the materials of the earth, the processes which shape its external features, vulcanism and its effects, earth movements and their results, earthquakes, and certain mineral resources. New facts and changes suggested by classroom use are included.

### OUR AMERICAN WEATHER

By DR. GEORGE H. T. KIMBLE. 344 pages, \$4.75

An exceptionally interesting book on all the aspects of weather in America written with that rare combination of wit and wisdom that transforms the subject into one of complete fascination. The author takes up each individual month of the year, explodes common superstitions, misunderstandings concerning the weather within these months, and gives a word portrait of weather conditions throughout the year that is highly literate and informative. Illustrated with maps and charts.

### HOW TO KNOW THE MINERALS AND ROCKS

By RICHARD M. PEARL, Colorado College. 192 pages, \$3.50

This is a practical field guide of more than 125 of the most important minerals and rocks, including gems, ores, native metals, and meteorites. It is simplified, authoritative, and up to date . . . written for the layman and for the beginning and amateur collector. By means of its simple keys anyone can identify typical specimens of minerals and rocks, as well as a number of unusual specimens that are of special interest to collectors, prospectors, and scientists.

### ISOTOPE GEOLOGY

By KALervo RANKAMA, University of Helsinki. 550 pages, \$12.00

Here is a book of great interest to practicing geologists, geophysicists, and geochemists, and to the oil and mining industries in general. It deals with how the isotopic constitution of the elements is used to determine the age of rocks and minerals, and how the energy released from radioactive processes relates to the history of the earth's crust. The subject finds applications in tracing oil and gas bearing formations and other mineral deposits of economic importance.

**McGRAW-HILL BOOK COMPANY, Inc.**

330 West 42nd Street • New York 36, N. Y.

# Meetings & Conferences

## April

- 10-15. American Inst. of Homeopathy, Washington, D.C. (W. R. Huntsman, AIH, 1601 Chestnut St., Philadelphia 3, Pa.)
- 10-15. American Inst. of Nutrition, San Francisco, Calif. (R. W. Engel, Dept. of Biochemistry and Nutrition, Virginia Polytechnic Inst., Blacksburg.)
- 10-15. American Soc. for Pharmacology and Experimental Therapeutics, San Francisco, Calif. (C. C. Pfeiffer, Emory Univ. School of Medicine, Emory Univ., Ga.)
- 10-15. Federation of American Societies for Experimental Biology, San Francisco, Calif. (M. O. Lee, 2101 Constitution Ave., Washington 25, D.C.)
- 10-16. American Physiological Soc., San Francisco, Calif. (M. O. Lee, 2101 Constitution Ave., Washington 25.)
- 10-16. American Soc. for Experimental Pathology, San Francisco, Calif. (C. C. Erickson, Inst. of Pathology, Univ. of Tennessee, 858 Madison Ave., Memphis.)
- 10-18. International Soc. of Urology, Athens, Greece. (Z. Kairis, 25 Voucourestiou St., Athens.)
- 11-14. Assoc. of American Geographers, annual, Memphis, Tenn. (B. W. Adkinson, Library of Congress, Washington 25, D.C.)
- 11-15. American Assoc. of Immunologists, annual, San Francisco, Calif. (F. S. Cheever, Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh 13.)
- 11-15. American Soc. of Biological Chemists, San Francisco, Calif. (P. Handler, Duke Univ. School of Medicine, Durham, N.C.)
- 12-15. International Union of Biological Sciences, 12th general assembly, Rome, Italy. (P. Weiss, 2101 Constitution Ave., Washington 25, D.C.)
13. Symposium on Recent Advances in the Use of ACTH, Cortisone, and Hydrocortisone in Veterinary Medicine, Boston. (R. R. Marshak, P. O. Box 707, Craigie Hill Rd., Springfield, Vt.)
- 13-15. Conf. on Biological Waste Treatment, New York, N.Y. (W. W. Eckenfelder, Civil Engineering Dept., Manhattan College, New York 71.)
- 13-16. Mathematical Assoc., conference, Leicester, England. (F. W. Kellaway, 87 Pixmore Way, Letchworth, Herts.)
14. World Meteorological Organization, 2nd cong., Geneva, Switzerland. (G. Swoboda, WMO, 1, Ave. de la Paix, Geneva.)
- 14-15. High Polymer Forum, 6th Canadian, cosponsored by Chemical Inst. of Canada, National Research Council of Canada and Polymer Corp., Inc., St. Catharines, Ontario, Canada. (D. G. Ivey, Dept. of Physics, Univ. of Toronto, Toronto.)
- 14-16. National Speleological Soc., Natural Bridge, Va. (E. Moffett, 3047 S. Columbus St., Arlington, Va.)
- 15-16. American Mathematical Soc., Brooklyn, N.Y. (AMS, 80 Waterman St., Providence 6, R.I.)
- 15-16. Eastern Psychological Assoc., Philadelphia, Pa. (G. Lane, Dept. of Psychology, Univ. of Delaware, Newark.)
- 15-16. Iowa Acad. of Science, Davenport. (J. L. Laffoon, Iowa State College, Ames.)
- 15-16. Louisiana Acad. of Sciences, joint meeting with New Orleans Acad. of Science, New Orleans. (E. S. Hathaway, 1423 Jefferson Ave., New Orleans 15.)

(See issue of 18 February for more comprehensive listings.)

## NEW REPRINTS

Ready February 1955

### Botanical Gazette

(Slightly reduced format)

	Price per set	Price per vol.
Vols. 1-20, 1875-1895, incl. General Index to Vols. 1-10 Cloth bound set, bound in 16 vols.	\$300.00	
Double vols., Vols. 1/2, 3/4, 5/6, 7/8, paper bound		\$20.00
Single vols., Vols. 9-17, paper bound		15.00
Single vols., Vols. 18-20, paper bound		20.00

### Zoological Record: Section Insecta

Vols. 1-20, 1865-1884 Paper bound set	225.00	
Single vols., paper bound		11.25

Also Available:

### Zoological Record

Vols. 1-20, 1864-1883 Cloth bound set	450.00	
Paper bound set	435.00	
Single vols., paper bound		22.50

Please address orders and inquiries to

**JOHNSON REPRINT CORPORATION**  
125 East 23 Street  
New York 10, N. Y.

## MATHEMATICAL METHODS FOR SCIENTISTS AND ENGINEERS

by LLOYD P. SMITH, Cornell University

This is a basic text that presents an unusually wide range of mathematical methods employed in the solution of modern technical problems. Great care has been taken to clearly designate all conditions necessary for applications of a given method to a particular problem without considering the detailed proofs involved. Also, great emphasis is placed on illustrating how advanced methods are actually used in science and engineering so as to develop the mathematical facility required to solve practical problems. Outstanding features: All of the many mathematical methods are illustrated by completely worked examples taken from scientific or engineering literature. Carefully developed sets of graded, unsolved problems follow each chapter. Treatment of Probability was written by Mark Kac, Department of Mathematics, Cornell University.

453 pages • 6" x 9" • Published 1953

## THE CHEMISTRY OF METAL CHELATE COMPOUNDS

by ARTHUR MARTELL, Clark University  
and MELVIN CALVIN, University of California, Berkeley

This is the first book to be published in the highly-important branch of metal complexes. It presents the principles of the structure and behavior of metal chelate compounds so as to be useful in the creation of new compounds and applications. Particular emphasis has been placed upon: Relationship of structure of chelating agent on stability of metal chelate formed . . . biological functions of metal chelates . . . chelates as catalysts in chemical reactions . . . complete lists of stability constants of metal chelates published through 1951 . . . studies of optical activity and related phenomena . . . complete glossary of terms.

613 pages • 6" x 9" • Published 1952

**PRENTICE-HALL, INC.**  
70 Fifth Avenue New York 11, N. Y.

# PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries — at a very low cost  
**CLASSIFIED:** 18¢ per word, minimum charge \$3.60. Use of Box Number counts as 10 additional words.

**DISPLAY:** Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

## POSITIONS WANTED

**Biologist, M.S.;** Endocrinology, Biochemistry, ageing-hormone relationships, trained in Manometric Techniques. Desires Biological research position. Box 65, SCIENCE. X

**Biologist, M.S.,** additional study in parasitology and bacteriology. 2 years instructor in Medical Parasitology. Desires college teaching position in Southeast. Box 64, SCIENCE. 3/18

(a) **Biophysicist;** Ph.D.; four years, research associate, university department of experimental pathology, two years, department of histology, four years, department of physiology. (b) **Pharmacologist;** Ph.D.; five years' full time teaching; six years, assistant president, pharmaceutical company in charge of clinical investigation, new product development. Medical Bureau, (Burneice Larson, Director), Palmolive Building, Chicago. X

**Chemist, M.S. (Chemical Economics),** Successful experience in laboratory supervision, industrial planning, foreign trade, college teaching (inorganic). Several publications. Age 37. Box 60, SCIENCE. X

**Entomologist;** M.Sc., recent graduate; background in chemistry, botany, zoology, economic entomology and insecticides. Desires position in research, teaching, industry. Box 61, SCIENCE. X

**General Scientist** in general education organization and instruction. Broad background and experience; research and university instruction in biological sciences. Ph.D. zoological sciences. Box 57, SCIENCE. X

**Microbiologist, B.S.;** four years experience; antibiotic assays, fermentations, germicides, mildew tests, toxicology. Very capable—desires responsible position. Box 63, SCIENCE. 3/18

**Medical writer, editor, author's assistant.** Production, research. Scientific or popular English. L. Cross, 505 E. 82 St., New York 28. X

**Microbiologist, D.V.M., Ph.D.,** 30, virology, pathogenic bacteriology, medical or veterinary desires academic position. Box 69, SCIENCE. 3/18

**Parasitologist,** masters degree desires position in research, public health, hospital or teaching. 5 years experience in parasitology and bacteriology. Box 67, SCIENCE. 3/18, 25; 4/1

**Physiologist, Ph.D.,** faculty medical college, principal investigator radiobiology, endocrinology, grants, publications. Box 66, SCIENCE. X

**Ph.D. Chemist,** biochemical background; extensive industrial experience in fields of natural products and medicinal chemicals; desires chemical-biochemical research; academic or industrial. Box 52, SCIENCE. 3/11

**LOOK AROUND...** notice the increasing number of satisfied advertisers using small-space ads regularly in practically every issue of SCIENCE—proof that these small ads get results! If you have a product or service of interest to scientists, take advantage of this low-cost means of increasing your profits!

## POSITIONS OPEN

**Assistantships.** Research and teaching appointments in Bacteriology. Specialized research in virology, general, pathogenic, soil, food and dairy bacteriology. Write Department of Bacteriology, Oregon State College, Corvallis, Oregon for information. 3/18, 25

**Biochemist (Literature)—M.S.** in biochemistry with major in biology and minor in organic chemistry to assist senior scientists in evaluation of scientific data. Research and Development Division of major Pharmaceutical Manufacturer offers advancement opportunities and liberal benefits. Outline complete education and experience. Box 59, SCIENCE. 3/18

**Biologist-Bacteriologist** with preferably some interest in Botany wanted by Mount Allison University, Sackville, N. B., Canada, to start September 1955. Apply W. B. Stallworthy, Department of Biology. 3/11, 18

(a) **Chairman** of chemistry department; Ph.D.; associate or full professor; women's college; woman preferred. (b) **Biochemist** to join staff of organization specializing in industrial research; duties: research and development; degree, experience required; Midwest. (c) **Pharmacologist** and, also, biochemist experienced in pharmaceutical research; research department, pharmaceutical company, East. (d) **Medical copywriter;** one of leading pharmaceutical companies; \$8000-\$8500. (e) **Microbiologist** to supervise department, 375 bed teaching hospital; East. S3-2 Medical Bureau, (Burneice Larson, Director), Palmolive Building, Chicago. X

**Curator of Mammals:** The applicant should possess knowledge of mammals and their care and will have responsibility for procurement, identification, housing, labelling, exhibition and maintenance of mammal specimens; this entails supervision of staff of head keepers, keepers and secretary. He should have the ability to write well and he may be expected to do research. The applicant should be a forward-looking individual with ability to project himself into the future and to consider new methods of exhibiting mammals, etc. He must work with others in the production of television, motion picture shows, etc. The compensation will be \$7,000 for a properly qualified individual. Apply Director, New York Zoological Park, New York 60, N. Y. X

**Microbiologist.** Ph.D. or equivalent. Excellent opportunity for individual with 3-5 years experience in infectious animal research and administrative ability. Research Division, Pharmaceutical Manufacturer, East. Box 62, SCIENCE. X

**Psychologist:** Psychology major, 22-28, with some courses in pre-clinical sciences, to assist senior bio-statistician in preparation of case reports of clinical investigations. Research Division of Pharmaceutical Manufacturer offers interesting opportunity and comprehensive benefit program. Box 58, SCIENCE. 3/18

**Senior Research Biochemist—Research laboratory** of Eastern Pharmaceutical Manufacturer desires Ph.D. in biochemistry or physiological chemistry including broad background in basic medical sciences. Opportunity for eventual administrative responsibilities. Industrial experience helpful. Send complete record of education and experience. Box 51, SCIENCE. 3/11, 18

**University of Toronto,** Department of Physics has an opening for a Lecturer in exploration geophysics at a salary of \$4,000.00. Acquaintance with gravimetric, electromagnetic and seismic instruments essential, field experience desirable. Appointment to commence September 1, 1955. Applications are also invited for a Research Fellowship made available through funds given to the University jointly by the California Standard Company and California Research Corporation, stipend \$1,800.00, open to students who have majored in physics preferably with some knowledge of geology. The research may be either in the field of exploration geophysics or in physics of the earth. Apply to Professor W. H. Watson, McLennan Laboratory, University of Toronto, Toronto 5, Canada. X

**AVOID DELAY . . . Cash in Advance payment**  
**MUST be enclosed with ALL classified ads.**  
**See "Charges and Requirements"**



# The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT



**CLASSIFIED:** 25¢ per word, minimum charge \$6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

**DISPLAY:** Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

## BOOKS AND MAGAZINES

**WANTED TO PURCHASE . . .**  
**SCIENTIFIC PERIODICALS and BOOKS**  
 Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted  
**WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.**

**Your sets and files of scientific journals**  
 are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC., Boston 19, Massachusetts

## PROFESSIONAL SERVICES

WISCONSIN  
ALUMNI  
RESEARCH  
FOUNDATION

## LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Amino acid assays and biological protein evaluations • Vitamin and antibiotic assays • Chick feeding tests • Pharmacology including warm-blooded toxicity studies • Phenol coefficient determinations

Write for price schedule

**WISCONSIN ALUMNI RESEARCH FOUNDATION**  
 P. O. BOX 2059-V • MADISON 1, WISCONSIN

## BOOK MANUSCRIPTS INVITED

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.

**VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1**  
 In Calif.: 6253 Hollywood Blvd., Hollywood 28



## FOOD RESEARCH LABORATORIES, INC.

Founded 1923

Philip B. Hawk, Ph.D., President  
 Samuel L. Oser, Ph.D., Director  
 Research • Analyses • Consultation  
 Biological, Nutritional, Toxicological Studies  
 for the Food, Drug and Allied Industries  
 48-14 33rd Street, Long Island City 1, N.Y.

• RESEARCH

• CONSULTATION

• ANALYSES

## PROFESSIONAL SERVICES

## CONSULTATION RESEARCH

MICROBIOLOGY  
PHARMACOLOGY  
BIOCHEMISTRY  
TOXICOLOGY  
ANIMAL HISTOPATHOLOGY

SOUTH SHORE

**ANALYTICAL AND RESEARCH LABORATORY, Inc.**  
 148 ISLIP AVE. ISLIP, N. Y.

## SUPPLIES AND EQUIPMENT

# BEAGLES

Healthy — AKC Registered — Immunized  
 \$25 to \$50 each; F.O.B. Ithaca  
 J. FATULA — Dog Farm — RRI — Ithaca, N. Y.

## • HYPOPHYSECTOMIZED RATS

Shipped to all points via Air Express  
 For further information write

**HORMONE ASSAY LABORATORIES, Inc. • 8159 South Spaulding Ave. Chicago 29, Ill.**

## \*\*\*\*\* SLIDE PREPARATIONS \*\*\*\*\*

Please write for list of several hundred available microscopic slide preparations on histology and pathological histology.

**WM. J. HACKER & CO., INC.**  
 82 Beaver St., N. Y. 5, N. Y.

# MICROPIPETTES

Quality unexcelled. Many sizes and styles available.

Write for Catalog 155A

## RESEARCH SPECIALTIES CO.

1148 Walnut St. Berkeley, Calif.

# The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

## SUPPLIES AND EQUIPMENT

### All AMINO ACIDS

natural, synthetic, unnatural,  
Rare Sugars, Biochemical Products, Reagents, New  
Pharmaceuticals in stock. Write or phone PLaza  
7-8171 for complete price list.

**BIOS LABORATORIES, INC.** 17 West 60th Street,  
New York 23, N. Y.

## RATS

Long-Evans (PAF)

Wistar (PAF)

*Bred for Research Work by Research Workers*

**PACIFIC ANIMAL FARMS**

2457 Fletcher Dr., Los Angeles 39, Calif.

### RARE MONOMERS

Vinyl Esters, Acrylyl and Methacrylyl Chlorides, Ethyl-  
enamines, Allyl Esters, Vinyl Halides, 4-Chlorostyrene,  
2,3-Dimethylbutadiene, Dimethylaminoethyl acrylate,  
300 other monomers. Write for list A-5.



### MONOMER-POLYMER

INCORPORATED • LEOMINSTER, MASS.



## SUPPLIES AND EQUIPMENT

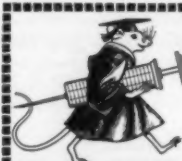
### ETHANOLAMINES

**C<sup>14</sup>**

and other tagged compounds  
OF HIGH RADIO-PURITY

**ISOTOPES SPECIALTIES INC.** 3816-A San Fernando Rd.  
Glendale 4, Calif.

German Cameras. Import your own. Save retailers, Importers  
profits. Example: Exakta, automatic Westanar F2.8 lens \$139.00  
(pay postman \$19.00 duty). We pay parcel post, insurance, and all  
other charges. Similar prices on all famous makes. New 1955 pro-  
duction. Payment through bank and inspection method guarantees  
full protection and satisfaction. Price lists, (please outline your  
interests for our technical advisory service) and details airmailed  
immediately. Worldpost, Tangier, Morocco. 3/18, 25; 4/1



### SWISS MICE

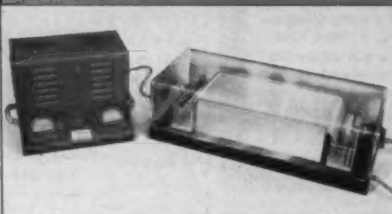
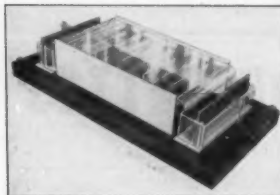
**TACONIC  
FARMS**

GERMANTOWN NEW YORK  
GERMANTOWN 3535

## The Reco

## PAPER ELECTROPHORESIS Apparatus

Reco specializes in the manu-  
facture of Chromatographic  
equipment. Write for General  
Catalog.



*With special water cooled  
surface for paper or solid  
media to prevent loss of  
water by evaporation  
or destruction of the  
sample by heat*

### SPECIAL FEATURES

**Water Cooled Surface for Paper or Starch...**  
The platform surface, on which buffer satu-  
rated filter paper or starch is placed, is cooled  
by circulating water (see illustration) to reduce  
evaporation and minimize change in buffer so-  
lution during operation, thus permitting use of  
high voltages.

**Power Unit** supplies 0-720 volts at 200 mili-  
amps continuously variable, with 3 1/2-inch volt-  
meter and 3 1/2-inch double scale miliamp meter  
reading 0-20 and 0-200 miliamps for accurate  
current measurements. Direct current measure-

ments. Direct current ripple is reduced by  
means of a choke-capacitor filter. Multiple  
power outlets available at nominal extra cost.  
For 115 volts AC.

**Anti-diffusion plates** in electrode troughs re-  
duce any changes in electrolyte at the paper  
due to electrolysis.

**Platform surface** is quickly adaptable for either  
paper or starch paste by means of end gates.

**Electrode vessels** easily dismantled for cleaning.

**Price:** \$290.00 complete with power unit.

MANUFACTURED BY

Write for Brochure SS-10

**RESEARCH EQUIPMENT Corporation**

1135 THIRD STREET • OAKLAND, CALIFORNIA

